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Effects of parental alcohol rules on risky drinking and related problems in adolescence:

Systematic review and meta-analysis

Sonia Sharmin[a], Kypros Kypri[a], Masuma Khanam[b], Monika Wadolowski[c], Raimondo Bruno[d],

John Attia[a], Elizabeth Holliday [a,e], Kerrin Palazzi[e], Richard P. Mattick[f]

[a]School of Medicine and Public Health, University of Newcastle, Newcastle, Australia;

Sonia.sharmin@uon.edu.au; kypros.kypri@newcastle.edu.au; john.attia@newcastle.edu.au

[b]School of Health Science, University of Tasmania, Hobart, Australia;

masuma.khanam@utas.edu.au

[c]Kirby Institute, University of NSW, Sydney, Australia; mwadolowski@kirby.unsw.edu.au

[d]School of Psychology, University of Tasmania, Australia; Raimondo.Bruno@utas.edu.au

[e]Clinical Research Design, Information Technology and Statistical Support (CReDITSS),

Hunter Medical Research Institute (HMRI), Newcastle, NSW, Australia;

Elizabeth.Holliday@hmri.org.au; Kerrin.Palazzi@hmri.org.au

[f]National Drug and Alcohol Research Centre, University of NSW, Sydney, Australia;

R.Mattick@unsw.edu.au

Corresponding author information:

Sonia Sharmin, CCEB, Level-4, HMRI Building, Kookaburra Circuit, New Lambton

Heights, NSW 2305, Australia; Telephone: +61 470367193; Sonia.sharmin@uon.edu.au

Abstract

Background: It is unclear what effect parents' rules about their children's alcohol use have on drinking in adolescence. This review and meta-analysis investigated associations between prospectively measured parental alcohol rules and later adolescent risky drinking.

Methods: Using the PRISMA guidelines, we searched eight electronic databases for a variety of terms up to 10 September 2016. We imposed no restrictions on publication year. We assessed the risk of bias and conducted a meta-analysis.

Results: We identified 13 eligible studies in four groups of specific exposures for meta-analysis. The pooled overall estimate showed that when parents set rules concerning alcohol, their children were less likely to develop risky drinking and related problems (OR = 0.64, 95% CI= 0.48, 0.86). Pooled estimates illustrate that parental alcohol rules were significantly negatively associated with adolescent risky drinking and related problems (OR = 0.73, 95% CI= 0.53, 0.99), as was parental approval of alcohol use (inverse OR = 0.41, 95% CI= 0.34, 0.50). Neither parental permissiveness (inverse OR = 0.83, 95% CI= 0.59, 1.19) nor parental disapproval of alcohol use (OR = 0.49, 95% CI= 0.20, 1.20) was significantly associated with alcohol-related problems. However, the small number of studies and variability in the point estimates in these latter two groups of studies limits inferences.

Conclusions: Parents' restrictiveness of their children's drinking was associated with lower risky drinking, but the risk of bias in the existing literature precludes strong inferences about the association. Further longitudinal studies with prospective measurement of parent behavior, low attrition, and control for likely confounders, are needed.

Key words: parental alcohol rules; alcohol; adolescent; risky drinking

1. Introduction

Risky drinking is a leading contributor to the global disease burden for adolescents (Gore et al., 2011; Patton et al., 2012). Risky drinking, defined as consuming ≥5 standard drinks on a single occasion at least monthly (Gore et al., 2011; Hill and Chow, 2002; National Institute on Alcohol Abuse and Alcoholism, 2016; Patton et al., 2012), is a cause of non-communicable disease, injury and sexually transmitted infection (Gore et al., 2011; Hill and Chow, 2002; Patton et al., 2012; Rehm et al., 2009). In the USA, approximately 14% of 12-20 year-old young people reported risky drinking in the last month (Center for Behavioral Health Statistics and Quality, 2015), and this age group required 188,706 emergency room visits because of alcohol-related injuries and disorders in 2011 (Substance Abuse and Mental Health Services Administration, 2013).

The rules parents set about alcohol may affect adolescent risky drinking, as parents are among the main agents of socialization of alcohol use during early adolescence (Abar and Turrisi, 2008; Jackson and Dickinson, 1999; Wood et al., 2004). It has been well-documented that parenting practices in general (e.g., support, monitoring, and parent-child attachment) are inversely related to adolescent risky drinking (Barnes et al., 1994; Danielsson et al., 2011; Kaynak et al., 2013; Kopak et al., 2012; Van Der Vorst et al., 2006). However, these broader parenting practices do not explain how parents respond to children's drinking, such as by implementing rules specific to their acquisition and use of alcohol. Alcohol-specific rules refer to clear, distinct instructions concerning alcohol use, expressed approval or disapproval of adolescent drinking, as well as consistency in the use of penalties for violating those rules (Chun et al., 2008; Janssen et al., 2014; Koning et al., 2012; Van Der Vorst et al., 2005; Van Zundert et al., 2006).

Evidence regarding the association between parental alcohol rules and adolescent risky drinking is conflicting. Some longitudinal studies find that lenience (e.g., parental approval or permissiveness of alcohol use) is associated with a higher likelihood of risky drinking in adolescence (Ennett et al., 2016; Loveland-Cherry et al., 1999). However, others do not find such an association (Fairlie et al., 2012; Reifman et al., 1998; Varvil-Weld et al., 2014). Some cross-sectional studies find that strict rules are associated with a lower prevalence of adolescent risky drinking (Habib et al., 2010; Van Der Vorst et al., 2005), while others find that adolescents are less likely to be involved in risky drinking and alcohol-related problems when they are permitted to drink at home under parental supervision (Bellis et al., 2007; Wells et al., 2005). This approach may teach adolescents to drink moderately and generalize to contexts where alcohol is available without adult supervision (Donovan and Molina, 2008). Conversely, by allowing adolescents to drink in any social context, parents may be communicating a permissiveness that extends unhelpfully to unsupervised environments (Van Der Vorst et al., 2010). Adolescents may assume that apparent permissiveness amounts to overt approval of their drinking (Van Der Vorst et al., 2006) and this may facilitate experimentation (Kaynak et al., 2014). These cross-sectional studies do not, of course, establish a temporal relation between exposure and outcome. Moreover, several studies did not adjust estimates of association for likely confounders [e.g., parent drinking (Maimaris and McCambridge, 2013; Viner et al., 2012)]. Therefore, the true association between parental alcohol rules and later adolescent risky drinking remains unclear.

To date, no reviews have synthesized longitudinal studies to investigate associations between prospectively measured parental alcohol rules and subsequent adolescent risky drinking. We aimed to critically investigate longitudinal studies and conduct a meta-analysis to address the

question: "Do the rules parents make about alcohol affect the likelihood that their adolescent children become risky drinkers?"

2. Material and methods

2.1 Selection and eligibility criteria

We used the PRISMA guidelines (Moher et al., 2015) and formulated eligibility criteria using the PICO (P– Populations/People/Patient/Problem, I–Intervention(s), C–Comparison, O–Outcome) worksheet and search strategy (Table 1) (Sackett, 1997).

We systematically reviewed prospective longitudinal studies including prospective cohort studies, randomized trials, and non-randomized trials, while excluding cross-sectional and retrospective studies. We specified a lag between exposure and outcome of 12 months or as close to 12 months as possible. We included published peer-reviewed English language journal articles without restriction on the year of publication. We included articles where different parenting factors including alcohol rules were combined as a predictor of adolescent risky drinking, as well as studies investigating the effectiveness of parent intervention. We excluded studies if, during the assessment of exposure, adolescents' age was close to 18 years [e.g., (Varvil-Weld et al., 2014)]. We included studies in which the terminology used to describe the outcome approximated the consumption of ≥5 drinks on a single occasion at least monthly, namely: *alcohol misuse*, *drunkenness*, *problem drinking*, *binge drinking*, *intoxication*, *peak drinking*, and *heavy episodic drinking*. We also included alcohol-related problems encompassing academic, social, health and legal consequences of alcohol use.

2.2 Search strategy

We searched eight electronic databases (Medline, MEDLINE In-Process & Other Non-Indexed Citations, EMBASE, PsycINFO, CINAHL, Scopus, Dissertations & Theses, and Cochrane Library) up to 10 September 2016, for the following core terms: *parenting, parental rules, parent approval, parental disapproval, parental permissiveness, adolescent, youth, risky drinking, binge drinking.* Search (mesh) terms were developed with the assistance of chief faculty librarian of the School of Medicine and Public Health at the University of Newcastle. Appendix Table 1 provides an example of the search strategy conducted in PsycINFO. Two reviewers (SS and MK) independently assessed titles and abstracts of articles and then screened full-text articles based on eligibility criteria to finalize articles for data extraction. They listed studies in separate Excel files, utilising a column to explain the reason for exclusion or inclusion of articles after reading titles and abstracts. Reviewers then met to check the concordance of their findings. They consulted with the third reviewer (KK) to resolve any disagreements that arose. Forward (Google Scholar) and backward (bibliographies of included articles) searches were performed to check if any articles were missed during initial searches. A third reviewer (KK) assessed the included articles independently to confirm inclusion based on the eligibility criteria. We contacted the authors of ten studies (Chun et al., 2008; Janssen et al., 2014; Koning et al., 2011; Koutakis et al., 2008; Loveland-Cherry et al., 1999; McMorris et al., 2011; Nash et al., 2005; Reifman et al., 1998; Reimuller et al., 2011; Van den Eijnden et al., 2011) to seek information regarding exact *p*-values, retention rates, what confounders were adjusted for, and whether blinding was used in trials. However, we received information from authors of only two studies regarding confounders and retention rate (Chun et al., 2008; Reifman et al., 1998). This review was registered in PROSPERO (reference: CRD42016032404) on 18 January 2016.

2.3 Data extraction and validity assessment

Two investigators (SS and MK) used the Cochrane Public Health Group Data Extraction and Assessment Template (Higgins and Green, 2008) to extract information from included articles. They assessed the risk of bias using the Cochrane risk of bias assessment tool for randomized trials (Higgins et al., 2011) and the Newcastle-Ottawa quality assessment scale for non-randomized studies (Wells et al., 2000). The Cochrane tool assesses trials based on seven domains: "random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective outcome reporting, and other biases" (Higgins and Green, 2008). We used the Newcastle-Ottawa quality assessment tool to evaluate three domains of nonrandomized studies: (1) *selection*, encompassing representativeness of the exposed adolescents, selection of the non-exposed adolescents, ascertainment of exposure, and demonstration that the outcome of interest was not present at the beginning of the study; (2) *comparability*, evaluating whether confounders were adjusted for; and (3) *outcome*, assessing the adequacy of the follow-up period, cohort retention and the ascertainment of outcome data (Wells et al., 2000). We appraised the quality of the studies by adding stars in each domain: 3 or 4 stars for selection, 1 or 2 stars for comparability, and 2 or 3 stars for the outcome domain signified 'good' quality; 2 stars for selection, 1 or 2 stars for comparability, and 2 or 3 stars for outcomes reflected 'fair' quality; and 0 or 1 star for selection, or 0 stars for comparability, or 0 or 1 stars for the outcome domain denoted 'poor' quality (Table 4) (Wells et al., 2000).

2.4 Statistical analysis (meta-analysis)

We conducted meta-analyses separately for four exposures reflecting the conceptualisation and language used in the primary research: parental alcohol rules, parental permissiveness of alcohol use, parental disapproval of alcohol use, and parental approval of alcohol use. In light of the overlap between these exposures, we also produced an estimate for all studies

combined. We inverted estimates of parental permissiveness of alcohol use and parental approval of alcohol use to put them on the same scale as parental alcohol rules and parental disapproval of alcohol use. Thus, all pooled effect estimates represent the effect of stricter (less permissive) parental behaviours in relation to alcohol use.

Across studies, different measures of exposure and outcome were used and results were reported in a variety of ways: odds ratios (OR), β coefficients, and correlation coefficients. Some studies did not report confidence intervals (CI) and standard errors (SEs), in which case we estimated standard errors using reported p-values. For studies that did not report an exact p-value, we followed a conservative approach, e.g., assuming $p=0.049$ when $p<0.05$. All indices were converted to log odds ratios (log OR) for meta-analysis. ORs and corresponding SEs were directly converted into log ORs and SElogORs; β coefficients and correlation coefficients were first converted into standardized mean differences (Cohen's d, with variance) and then transformed into log ORs and SElogORs. The logORs and SElogORs for each study were pooled to produce a summary effect size estimate as an OR with 95% CI. We conducted a sensitivity analysis by removing studies of each exposure in turn and estimating effect estimates of prospective studies and randomized trials separately to determine the overall effect on the meta-analytic estimate. We produced contour-enhanced funnel plots and conducted Begg's (Begg and Mazumdar, 1994) and Egger's (Egger et al., 1997) tests to evaluate publication bias. Data conversion and analysis of publication bias were performed in Stata version 13.1 (STATA Data Analysis and Statistical Software) and the forest plot was produced in SAS version 9.4 (SAS).

3. Results

From the initial database searches, we identified 1740 records and exported them to Endnote X7 reference management software (Thomson Reuters Endnote X7). We identified three further articles from backward and forward searches, removed 620 duplicate articles, and screened the remaining articles by reading titles and abstracts. We excluded articles that did not meet inclusion criteria for full-text review, i.e., conference abstracts, review articles, cross-sectional or retrospective studies, articles in which the exposure was not parental alcohol rules or the outcome was not risky drinking. Finally, we assessed the full text of 80 articles for eligibility, from which 14 were included, data extracted and results summarized (Figure 1).

3.1 Study characteristics

Seven studies were conducted in the USA, three in the Netherlands, three in Sweden and one in both the USA and Australia (Table 2). Four studies were randomized trials (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008; Loveland-Cherry et al., 1999), and the others were prospective cohort studies. We defined exposure as 'parental alcohol rules' for eight studies (Bodin and Strandberg, 2011; Chun et al., 2008; Janssen et al., 2014; Koning et al., 2011; Koutakis et al., 2008; Reifman et al., 1998; Strandberg et al., 2014; Van den Eijnden et al., 2011), 'parental approval of alcohol use' for two studies (McMorris et al., 2011; Stice et al., 1998), 'parental disapproval of alcohol use' for four studies (Loveland-Cherry et al., 1999; Nash et al., 2005; Reifman et al., 1998; Reimuller et al., 2011), and 'parental permissiveness of alcohol use' for three studies (Levitt and Cooper, 2015; Loveland-Cherry et al., 1999; Reimuller et al., 2011). These four exposures were not consistently measured across studies. For example, Bodin and Strandberg (2011) assessed the effectiveness of a prevention program where they advised parents to apply strict rules against alcohol use. Nash, McQueen and Bray (2005) measured parental disapproval of alcohol use

by asking adolescents whether their parents were very much against alcohol use, which overlaps with parental strict alcohol rules. Chun et al. (2008) defined alcohol rules as penalties for violating rules, asking adolescents, "whether they would be in trouble due to their alcohol consumption." In the study by Janssen et al. (2014) alcohol rules indicated parental approval of alcohol use in different settings with questions relating to specific contexts, e.g., "in the absence of parents at home" or "at a friend's party". Similarly, Reimuller, Hussong and Ennett (2011) in their study of alcohol-specific rule setting defined parental permissiveness in terms of whether children were required to seek their parents' permission before drinking.

Three randomized trials tested the Örebro Prevention Programme, which aimed to encourage parents to set strict rules against youth drinking (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008). In the other randomized trial, a family intervention program aimed to enhance parenting practices, improve parental monitoring, increase parental knowledge about consequences of adolescent drinking, and minimize permissiveness of adolescent drinking (Loveland-Cherry et al., 1999).

Outcomes were defined variously as 'drunkenness' (how many times the adolescent drank enough to feel drunk in the last 4 weeks) (Bodin and Strandberg, 2011; Koutakis et al., 2008; Strandberg et al., 2014), 'heavy episodic drinking (HED)' (Janssen et al., 2014; Reifman et al., 1998) or 'alcohol misuse' (Loveland-Cherry et al., 1999), 'heavy drinking'(Levitt and Cooper, 2015), 'heavy weekly drinking' (Koning et al., 2011), 'problem alcohol use' (Nash et al., 2005; Stice et al., 1998) or 'alcohol-related problems' [(Rutgers Alcohol Problem Index (White and Labouvie, 1989)] or 'negative alcohol-related consequences' (McMorris et al.,

2011; Reimuller et al., 2011; Van den Eijnden et al., 2011) and 'high volume drinking' (Chun et al., 2008).

In thirteen of the studies, follow-up periods were ≥6 months; one study's follow-up period was three months (Chun et al., 2008). The age range of samples was 9-15 years at baseline, and 15-30 years at last follow-up. Sample sizes ranged between 160 and 5220. Parental alcohol rules were reported by an adolescent or both an adolescent and a parent. Most of the studies were set in schools, and all were published between 1998 and 2015.

3.2 Summary of study findings

3.2.1 Randomized trials of parent/family interventions

Interventions with parents encouraged them to establish strict rules against adolescent drinking (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008), while interventions with families encouraged parents to create a supportive family environment, to monitor their children, to learn about the consequences of adolescent drinking, to express disapproval of alcohol use by their children, and to be less permissive of alcohol use (Loveland-Cherry et al., 1999). A Swedish randomized trial of the Örebro Prevention Programme, which aimed to increase strict parental rules against adolescent alcohol use, was effective in reducing adolescent drunkenness and frequent drunkenness among grade 9 students (at age 16 years) when it was implemented between 1999 and 2001 (Koutakis et al., 2008). In contrast, in a later Swedish trial of the same intervention implemented between 2007 and 2010, Bodin and Strandberg (2011) found that the intervention had no effect on adolescent drunkenness. A Dutch trial also evaluated the Örebro Prevention Programme among parents, in addition to a student intervention, and both interventions combined. This trial found no effect of either the individual parent intervention or the student intervention on

the incidence of heavy episodic drinking at 3-year follow-up (Koning et al., 2011). There was, however, an effect of the combined intervention (parents and students) on this outcome, and the effect increased over time.

In a US trial, a subgroup analysis suggested that a family intervention was effective in reducing adolescent risky drinking only among adolescents without prior drinking experience, compared with counterparts in the control group who had no prior drinking experience. This subgroup analysis showed that the prevalence of risky drinking continued to increase among adolescents with prior drinking in the intervention group, but their overall level of risky drinking was lower than that of their counterparts in the control group (Loveland-Cherry et al., 1999). The possibility of an intervention effect on adolescents with prior drinking should be interpreted cautiously given the post-hoc nature of this analysis (Cook et al., 2004; Oxman and Guyatt, 1992) and the small number of adolescents in the subgroup (n=61). In addition, the study design does not permit inferences as to which components of the family program were active in reducing risky drinking, if the effect was indeed real.

In the three European trials we identified, sample sizes were large (ranging from 900 to 3490 adolescents and parents) and representative enough to support inferences about the effectiveness of parent interventions (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008). Inferences from these randomized trials (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008) are limited by lack of clarity in the reports regarding random sequence generation, allocation concealment, blinding of participants, and outcome assessment. In the US trial, the small sample size, particularly in the intervention

group (n=90) constrains inferences about the effectiveness of the family intervention (Loveland-Cherry et al., 1999).

3.2.2 Evidence from prospective cohort studies

3.2.2.1 Parental alcohol rules

A Dutch study found parental strict alcohol rules among 14 year-old adolescents were associated with decreased risky drinking two years later (OR=0.32, 95%CI=0.21, 0.49) (Janssen et al., 2014), whereas a Swedish study (Strandberg et al., 2014) identified a significant association for girls only (OR=0.57, 95%CI=0.36, 0.90). In a US study, Chun et al. (2008) found that increased penalties for violating parental alcohol rules were associated with less adolescent risky drinking. In a Dutch cohort, Van den Eijnden et al. (2011) found no significant association between parental alcohol rules and alcohol-related problems two years later. Conversely, in a US cohort, Reifman et al. (1998) found that strict parental alcohol rules in year one of the study were associated with increased odds of heavy episodic drinking in the following year, but not between years two and three.

3.2.2.2 Parental approval of adolescent drinking

In the study of Stice, Barrera & Chassin (1998), parental approval of adolescent alcohol use (baseline adolescent mean age 14 years) was correlated with adverse consequences of alcohol consumption a year later (coefficient=0.28). McMorris et al. (2011) found that adult supervised alcohol use by 8th grade adolescents in different contexts (e.g., dinners, special occasions, parties) was associated with alcohol-related harms in 9th grade (coefficient=0.22). Moreover, parental attitudes permitting 8th grade alcohol use were linked indirectly to adolescent alcohol-related harm when adult-supervised drinking mediated the relationship.

3.2.2.3 Parental disapproval of adolescent drinking

A US study revealed that mothers' disapproval of adolescent alcohol use was associated with reduced heavy episodic drinking one year later (OR=0.55, p<0.06), but not between years two and three of the study (OR=0.64) (Reifman et al., 1998). In another US study, Nash et al. (2005) indicated that higher parental disapproval of adolescent alcohol use (mean age 15.5 years) was associated with fewer alcohol-related problems. However, Reimuller et al. (2011) did not find an association between parental disapproval of adolescent drinking and alcohol-related harm.

3.2.2.4 Parental permissiveness of adolescent drinking

In a US study, Reimuller et al. (2011) found no significant association between parent permissiveness of adolescent drinking and later alcohol-related problems among adolescents. Levitt and Cooper (2015) found that adolescents (mean age 15.1 years) from intact families (i.e., living with biological parents) who were allowed to drink at home, had the lowest level of alcohol-related problems over time. Conversely, adolescents from non-intact families who were allowed to drink at home had the highest level of alcohol-related problems.

3.3 Assessment of study validity

3.3.1 Assessment of risk of bias in randomized trials

Methodological studies suggest that inadequate randomization and lack of blinding of participants and outcome assessors bias intervention effect estimates (Moher et al., 1998; Pocock, 1979; Schulz et al., 1995). Koutakis et al. (2008) did not clearly report random sequence generation, concealment of allocation, and blinding, which may have caused over- or underestimation of intervention effects (Koutakis et al., 2008). Two trials reported using random assignment to intervention and adequate concealment of allocation but did not

indicate whether participants and outcome assessors were blinded (Bodin and Strandberg, 2011; Koning et al., 2011). Loveland-Cherry et al. (1999) used random assignment but did not report clearly on allocation concealment and blinding. Attrition was low in three of the trials, ranging from 7-14% (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008). The fourth trial reported that a significant number of parents was lost to follow-up but did not provide the number (Loveland-Cherry et al., 1999). Trials relied on self-reported exposures and outcomes that may have produced information bias. Overall, the risk of bias was judged to be high in the four trials (see Table 3).

3.3.2 Assessment of risk of bias in prospective cohort studies

3.3.2.1 Selection

Studies selected exposed and non-exposed groups from the same population. Our search identified prospective cohort studies from four high-income countries (USA, Netherlands, Sweden and Australia) which traditionally restrict youth alcohol use (Babor et al., 2010). The association between parental alcohol rules and adolescent risky drinking may not generalize to so-called 'wet' countries (e.g., in southern Europe) where small amounts of alcohol are commonly served with meals (Rehm et al., 2003).

3.3.2.2 Measurement of exposure and outcome

Six studies ascertained the exposure of interest from adolescent self-report (Chun et al., 2008; Janssen et al., 2014; Levitt and Cooper, 2015; McMorris et al., 2011; Nash et al., 2005; Van den Eijnden et al., 2011) and four studies assessed exposure from both parent and adolescent self-report (Reifman et al., 1998; Reimuller et al., 2011; Stice et al., 1998; Strandberg et al., 2014). If parental alcohol rules were under-reported by the participants, this might result in bias toward the null (non-differential misclassification) (Rothman et al., 2008). The true

association between parental alcohol rules and adolescent risky drinking would then be stronger than estimated.

It is possible that parents provided socially acceptable responses regarding their alcohol rules. Some studies have identified incongruence between parent and adolescent reporting of general parenting factors (Abar et al., 2015; Cottrell et al., 2003; Kerr and Stattin, 2000). Cottrell et al. (2003) found that 57% of adolescents reported that their parents always knew their whereabouts whereas 84% of parents reported they knew their children's whereabouts. It is unknown whether such misreporting, if it occurred in the studies we examined, would be differential with respect to exposure, and therefore how effect estimates may be biased.

It is also difficult to assess the effect of systematic misreporting of the outcome (Rothman et al., 2008). Studies relying on self-report of adolescents may have under- or over-estimated alcohol consumption. However, methodological studies suggest that self-reporting of alcohol use is reasonably robust in settings where confidentiality is assured during data collection, and where participants do not expect their responses to be judged by parents, peers or researchers (Campanelli et al., 1987). Parent consent was obtained in five studies (Chun et al., 2008; Janssen et al., 2014; McMorris et al., 2011; Nash et al., 2005; Van den Eijnden et al., 2011) and student assent was obtained in two studies (Chun et al., 2008; McMorris et al., 2011) before the onset of data collection. In five studies participants were assured of confidentiality during data collection (Bodin and Strandberg, 2011; Chun et al., 2008; Janssen et al., 2014; Stice et al., 1998; Strandberg et al., 2014). In the remaining studies, reports did not explain this aspect of the procedure.

3.3.2.3 Confounding

The reports of four studies did not explain which potential confounders were adjusted for (Janssen et al., 2014; Nash et al., 2005; Reimuller et al., 2011; Strandberg et al., 2014) and one reported not adjusting for confounders at all (Chun et al., 2008). Most of the studies did not adjust estimates for likely confounders such as parental supply of alcohol, parent drinking, peer drinking and sibling drinking, which have been found to be associated with adolescent risky drinking in prospective cohort studies [e.g., (Fergusson et al., 1995)] and may be related to parental alcohol rules (Fergusson et al., 1994). Confounding bias may, therefore, have inflated effect estimates.

3.3.2.4 Attrition

Attrition ranged from 25-40% in five studies (Levitt and Cooper, 2015; Nash et al., 2005; Reimuller et al., 2011; Strandberg et al., 2014; Van den Eijnden et al., 2011), suggesting a high likelihood of attrition bias. One study did not report the attrition fraction (Janssen et al., 2014). In 13 studies, the median duration of follow-up (≥6 months) was adequate to assess outcomes if parental alcohol rules were a causal factor. Overall, after formally assessing risk of bias (see Table 4), we rated two studies as 'good,' one as 'fair' and seven as 'poor' in quality.

3.4 Meta-analysis

Two studies reported effect estimates of both parental permissiveness of alcohol use and parental disapproval of alcohol use (Loveland-Cherry et al., 1999; Reimuller et al., 2011). We included the estimate of parental disapproval of alcohol use from these two studies when calculating an overall estimate to avoid including multiple outcomes from a single study. To estimate the sub-total of four exposures we used effect estimates of eight studies for parental alcohol rules (Bodin and Strandberg, 2011; Chun et al., 2008; Janssen et al., 2014; Koning et

al., 2011; Koutakis et al., 2008; Reifman et al., 1998; Strandberg et al., 2014; Van den Eijnden et al., 2011), three studies for parental permissiveness of alcohol use (Levitt and Cooper, 2015; Loveland-Cherry et al., 1999; Reimuller et al., 2011), three studies for parental disapproval of alcohol use (Loveland-Cherry et al., 1999; Reifman et al., 1998; Reimuller et al., 2011), and two studies for parental approval of alcohol use (McMorris et al., 2011; Stice et al., 1998). One study excluded from the meta-analysis was ineligible because it used incomparable analytic methods (Nash et al., 2005).

The pooled overall estimate (Figure 2) shows that when parents set rules concerning alcohol, their children were less likely to become risky drinkers (OR = 0.64, 95% CI= 0.48, 0.86; I^2 = 91%; p<0.001). The sensitivity analysis confirmed the robustness of the result (Appendix Table 2). The subtotal estimates (Figure 2) illustrate that parental alcohol rules were significantly associated with decreased adolescent risky drinking (OR = 0.73, 95% CI= 0.53, 0.99; p=0.046; I^2 = 79.8%), as was parental approval of alcohol use (inverse of OR = 0.41, 95% CI= 0.34, 0.50; p<0.001; I^2 = 29.3%). However, neither parental permissiveness of alcohol use (inverse of OR = 0.83, 95% CI= 0.59, 1.19; p=0.558; I^2 = 81.5%), nor parental disapproval of alcohol use (OR = 0.49, 95% CI= 0.20, 1.20; p=0.323; I^2 = 96.5%) was significantly associated with adolescent alcohol-related problems. The small number of studies and variability between the point estimates in these two latter groups of studies limits inferences about the associations of interest.

The contour enhanced funnel plot revealed no evidence of publication bias because it seems unlikely that studies remained unpublished in both low and high statistical significance areas (Appendix Figure 1). Begg's (p= 0.827) and Egger's (p= 0.227) tests also did not confirm the presence of publication bias.

4. Discussion

Our meta-analysis suggests that parental rules concerning alcohol use may decrease the odds of risky drinking later in adolescence. However, there is a fair possibility that the pooled estimate is compromised by confounding bias, attrition bias, and limitations in trial design. Pooled estimates should not be considered generalizable as the I^2 statistic and p-value suggest considerable heterogeneity across studies.

The strengths of this review and meta-analyses include the explicit and comprehensive search strategy, and independent screening of studies, data extraction, coding and risk of bias assessment. Meta-analyses increased the precision of the point estimates. Previous reviews of this literature suffer from methodological shortcomings, for example, the inclusion of cross-sectional studies that could not determine temporality [e.g., (Ryan et al., 2010)]. In this review, we included randomized trials, the most rigorous research design for determining the effect of parenting strategies in reducing adolescent risky drinking. We also included prospective cohort studies, establishing at least that the outcome of adolescent risky drinking was preceded by exposure to rules set by parents. This design, however, does not exclude the possibility of more complex explanations for the observed associations. For instance, initially, parents may approve moderate drinking during early or mid-adolescence to make their children responsible drinkers. However, adolescents may enjoy the effects of alcohol, potentiating risky drinking and thereby demands for parents to be more lenient toward their drinking.

4.1 Limitations

For the forest plot, we had to produce effect estimates on different scales to those used in the original studies. The process of estimating, transforming and standardizing estimates from different scales (i.e., β to Cohen's d to lnOR) may introduce error and result in confidence intervals that are wider than would apply to the original estimates. This is especially the case for studies with small but statistically significant β coefficients (Chun et al., 2008). Furthermore, the process of estimating p-values when they were not specified (i.e., using p=0.049 as an approximation for p<0.05) introduces bias into the estimates of variance, reducing the power of meta-analyses.

Across studies different measures of exposures were used. For instance, Chun et al. (2008) defined alcohol rules as penalties for violating rules, while Janssen et al. (2014) measured parental alcohol rules using a 10-item scale in terms of parental approval of alcohol use in various settings. Advancement in understanding of this area is constrained by a lack of clarity in studies (possibly reflecting uncertainty among parents), as to what constitutes rule setting (e.g., how explicit they have to be, how often messages have to be repeated, and what adolescents understand of them), and how rules relate to parents' attitudes and behaviour. There may be value in further qualitative studies investigating parent [e.g., (Kypri et al., 2007)] and adolescent perceptions of rule setting to guide conceptualisation and measurement in future observational studies and intervention trials.

Studies also defined outcome variables differently, e.g., ≥5 drinks in a sitting (Janssen et al., 2014; Levitt and Cooper, 2015; Strandberg et al., 2014), frequency of becoming drunk in the past month (Bodin and Strandberg, 2011; Chun et al., 2008; Koutakis et al., 2008), and alcohol-related problems (Loveland-Cherry et al., 1999). This inconsistency limits the comparability of the studies.

None of the randomized trials tested for possible mediating variables in evaluating the outcome of intervention (Bodin and Strandberg, 2011; Koning et al., 2011; Koutakis et al., 2008; Loveland-Cherry et al., 1999). For instance, Koutakis et al. (2008) found parent intervention was effective in reducing adolescent drunkenness but did not test the mediating mechanisms. Recently, Ozdemir and Koutakis (2016) examined the mediating role of parent attitudes in this trial. They found that in the parent intervention group, restrictive attitudes toward adolescent drinking increased over time. Moreover, fewer adolescents were found to be drunk over time with increasing parental restrictiveness.

No longitudinal studies distinguished whether adolescents were permitted to drink whole beverages under supervision or merely sip from their parents' drinks (Sharmin et al., 2017). Numerous studies on adolescent drinking initiation categorize sipping as drinking; however, a prospective study examining this distinction found that sipping in childhood was not related to later adolescent risky drinking while drinking whole drinks was (Wadolowski et al., 2015).

In the studies included in this review, the age of participants at baseline ranged from 9 to 15 years. For pragmatic reasons, in light of the small number of studies, we assumed that hypothesised effects of parental alcohol rules were equivalent across this age range. In all of the studies [except that by Levitt et al. (2015), where it was 30 years], the age of participants at the final follow-up assessment was 15-17 years. However, Levitt et al. (2015) estimated the association between drinking at home and heavy drinking when participants had a mean age of 14 years, within the range of the other studies.

Studies typically did not examine possible gender differences in the impact of parental alcohol rules. An exception was Strandberg et al. (2014), who found that stricter parental alcohol rules predicted decreased frequent drunkenness in girls, but not in boys.

In accordance with the eligibility criteria, we included peer-reviewed journal articles published in English. Thus, exclusion of articles published in other languages limits the generalizability of our estimates.

5. Conclusion

This systematic review and meta-analysis suggest that parental rules concerning alcohol decrease the likelihood of risky drinking later in adolescence. However, we judged that the studies have a high risk of bias and the true association may be over-estimated. Inferences about the association are limited by the small number of studies suggesting further longitudinal studies are needed, in different cultural settings, and with designs and methods that minimize the risk of bias.

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Table 1: PICO Worksheet (parental rules about alcohol and adolescent risky drinking)

Population	Adolescents whose exposure assessment occurred prior to the age of 18 years.
Intervention	Parental alcohol rules (strict/ lenient); for instance, parental approval or disapproval of adolescent drinking (supervised/ unsupervised access), parental permissive alcohol rules.
Comparison	We compared children who were exposed or unexposed to parental rules about alcohol.
Outcome	The outcome is adolescent risky drinking defined as drinking ≥5 standard drinks on a single occasion at least monthly. Different terms were used in the studies as risky drinking: alcohol misuse, drunkenness, problem drinking, binge drinking, intoxication, peak drinking, heavy episodic drinking, and alcohol-related problems. Here, alcohol-related problems include academic, social, health and legal consequences due to excessive alcohol use. We considered all of these as risky drinking for this review.

Table 2: Study characteristics and results

Author	Study design	Country	Sample (at baseline)	Mean age at baseline (Years)	Follow-up	Study Details	Exposure	Outcome	Results
Bodin, & Strandberg (2011)	Cluster randomized trial	Sweden	1752 adolescents 1314 parents	13	12 and 24 months	The prevention program aimed to encourage parents to apply strict alcohol rules against adolescent drinking.	Parental alcohol rules.	Drunkenness (Past month)	Significant program effect was not found on frequent adolescent drunkenness. Multiple imputation at T2: OR=0.59, 95% CI=0.34,1.02 Multiple imputation at T3: OR= 1.04, 95% CI= 0.63, 1.72
Chun et al. (2008)	Prospective cohort study	USA	160 adolescents 160 parents	15.6	3 months	Adolescents were included in this study if evidence of alcohol was identified in blood, breath, or saliva or if adolescents attended emergency department (ED) due to injury and reported drinking	Parental alcohol rules.	Combined drinking, risky drinking, and drunkenness (Past 3 months)	Penalties for violating rules were significantly associated with less adolescent risky drinking. β = -0.244; SEB= 0.204

						alcohol 6 hours before visiting ED.			
Janssen et al. (2014)	Prospective cohort study	Netherlands	252 adolescents	14.6	6, 12, 18, and 24 months	Analysis was limited to the adolescents aged between 13 and 16 and who provided information at least at two-time points of data collection.	Parental alcohol rules.	Risky drinking (Past month)[b]	Parental alcohol-specific rules were significantly associated with adolescent HED[a]. OR=0.32, 95% CI=0.21,0.49
Koning et al. (2011)	Cluster randomized controlled trial	Netherlands	2937 adolescents Parent Intervention: 603 and their parents (302 male). Control Intervention: 677 (378 Male) students and their parents.	12.6	34 months	Parent intervention targeted to encourage parents about restrictive rule-setting to affect adolescent alcohol use.	Parental alcohol rules	Risky drinking (Past week)[c]	Parent intervention was not effective on adolescent heavy weekly drinking. OR= 0.83, p=0.14, NNT= 62.5
Koutakis, Stattin, & Kerr (2008)	Randomised trial	Sweden	Intervention: 437 adolescents and 339 parents Control: 458 adolescents	13	12 and 24 months	Information provided to parents (intervention group) by mail and meetings to	Parental alcohol rules.	Drunkenness (Past month)	Parents were significantly stricter in the intervention group than those in control group, $F_{(1,503)}$=35.78,

Author	Study design	Country	Sample	Age	Follow-up	Intervention/Aim	Variable	Outcome measure	Results
			and 312 parents			follow strict rules about their adolescent children's alcohol use. The control group did not receive any information.			p<0.001. Sharp increase of drunkenness was found among the control group compared to the intervention group, $F_{(1.35,791.85)}$=12.00, P<0.001.
Levitt and Cooper (2015)	Prospective cohort study	USA	772 adolescents 772 parents	15.1	6 years, 7 years (only parents participated), 12 years, 13 years, 14 years.	Parents of under 18-year-old adolescents were interviewed in the 7 year follow-up.	Parental permissiveness of alcohol use.	Heavy drinking (Past 6 months)[d] Drinking problems (Past 6 months)	Allowing adolescent to drink at home did not predict heavy drinking and drinking problems. Heavy drinking: b = -0.010, SE = 0.156, p = 0.951, 95% CI = -0.316, 0.296 Drinking problems: b =-0.064, SE = 0.057, p = .261, 95% CI = -0.176, 0.048
Loveland-Cherry, Ross & Kaufman (1999)	Randomized trial	USA	892 adolescents 892 parents	9[e]	12, 24, 36 and 48 months	The family intervention aimed to enhance protective factors and minimize risk factors that influence adolescent	Parental permissiveness of adolescent drinking Parental disapproval of adolescent drinking	Risky drinking (Past year)	Correlation: Parental disapproval of alcohol with adolescent alcohol Misuse: Pretest: -.35 Time 1: -0.4 Time 2: -.46 Time 3: -.27 Time 4: -.38

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						alcohol use.			Parental permissiveness and adolescent alcohol misuse: Pretest: .05,NS Time 1: .17 Time 2: .16 Time 3: .03, NS Time 4: .21 MANOVA: Students in the intervention group reported less alcohol misuse than the control group (U= 10070.5, asymptotic p= .04). However, the result was not significant for adolescents with prior drinking practices (U=213.5, a symptotic p=.16).
McMorris et al. (2011)	Prospective cohort study	USA and Australia	1888 adolescents 1888 parents	13.0	12 and 24 months.	Followed matched procedures to collect data from two states.	Parental approval of alcohol use.	Negative alcohol consequences.	For adolescents in both states, adult-supervised drinking in grade 8 was associated with alcohol-related harms in Grade 9 (coefficient=.22). Favorable parent attitude regarding

									adolescent alcohol use in grade 7 was associated with alcohol-related harm in grade 9 (coefficient=.18).
Nash, McQueen & Bray (2005)	Prospective cohort study	USA	2573	15.5	12, 24 and 36 months	Authors only included adolescents in their analysis if the adolescent indicated that both mother and father were in agreement regarding adolescent alcohol use.	Parental disapproval of alcohol use.	Alcohol use problems	Higher parental disapproval of alcohol was associated with less alcohol-related problems.
Reifman et al. (1998)	Prospective cohort study	USA	699 adolescents	13-16[f]	12 and 24 months	Households which had at least one adolescent aged between 13-16 years were eligible to include in this study.	Parental disapproval of alcohol use. Parental alcohol rules.	Risky drinking (Past year)[d]	Mothers' disapproval of adolescent drinking decreased the odds of adolescent HED[a] between one and two years but not significantly decreased HED[a] between two and three years. Mother's disapproval W1 to

									W2 (n=475): OR= 0.55, p<.06 Mother's disapproval W2 to W3 (n=345): OR= 0.64
									Rules against adolescent drinking in year of the study increased odds of HED[a] in the next year, but not between two and three years. Rules against alcohol W1 to W2 (n=475): OR= 2.51, p<.05 Rules against alcohol W2 to W3 (n=345): OR= 1.50
Reimuller, Hussong & Ennett (2011)	Prospective cohort study	USA	5220 adolescents 1663 parents	14.01	6, 12, 18, 24, 30 and 36 months	Adolescents were ineligible to participate if they were Exceptional Children and not proficient in reading English.	Parental permissiveness of alcohol use. Parental disapproval of alcohol use.	Negative alcohol-related consequences (Past 3 months)	No significant direct association was found between permissive messages and adolescent alcohol-related problems. β=0.02 (0.02) ; t-value=0.91 Parental permissive communication predicted

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										increased amount of alcohol use and problems if adolescents started their drinking at baseline. Permissive messages*Adolescent baseline alcohol use, β=0.03 (0.02), p<.05; t-value=1.99
										No relationship was found between parental disapproval of adolescent drinking and negative alcohol-related consequences. β= −0.01 (0.02) ; t-value= −0.80
Stice, Barrera, & Chassin (1998)	Prospective cohort study	USA	454 adolescents 454 parents	14.2	12 months	65% of the adolescents were children of alcoholics.	Parental approval of alcohol use.	Negative alcohol-related consequences (Past year)	Parental approval of adolescent alcohol use was correlated with alcohol-related negative consequences at12-month follow-up (coefficient=.28). Standardized path coefficient found T1 parental approval of

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Author (Year)	Study design	Country	Sample	Age	Follow-up	Setting	Determinant	Outcome	Results
									alcohol had a direct effect on T2 negative consequences, controlling T2 alcohol use (.13, p<.05).
Strandberg, Bodin & Romelsjo (2014)	Prospective cohort study	Sweden	1752 adolescents 1314 parents	13.0	12 and 30 months	40 municipal schools participated from 13 Swedish counties.	Parental alcohol rules.	Drunkenness (past month)	Parental strict alcohol-specific attitude had decreased frequent drunkenness of girls (OR=0.57, 95%CI= 0.36, 0.90). For boys parental stringent alcohol-specific attitude did not significantly predict frequent drunkenness (OR=0.88, 95%CI= 0.39, 1.99).
Van den Eijnden et al. (2011)	Prospective cohort study	Netherlands	5334 adolescents	13.4	24 months	13 high schools and 3 schools for professional education participated.	Parental alcohol rules.	Negative alcohol-related consequences (Past year).	No significant association was found between parental alcohol rules and alcohol-related problems. Model mother: β=-.08 Model father: β=-.07

[a]Heavy Episodic Drinking (HED)

[b]Risky drinking (boys: ≥5 drinks on a single occasion; girls: ≥4 drinks on single occasion)

[c]Boys drinking at least 5 glasses and girls at least 4 glasses every week

[d]Drinking ≥5drinks on a single occasion and frequency of alcohol use

eThe average age was not reported, but participants were recruited via Grade 4 classes, for which the average age is 9 years-old
fAverage age was not reported.

Table 3: Cochrane risk of bias assessment

Study	Random sequence generation	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective outcome reporting? (reporting bias)	Other bias
Bodin & Strandberg (2011)	Low (schools were regarded as the randomization unit of choice)	Low (sealed opaque envelopes containing school's names were used and allocated to groups by coin-tossing)	High (non-blinded study design)	Unclear	Low (92.1% participated in 12-month follow-up, and 88.4% participated in 24-month follow-up)	High (self-reported data)	High (unsuccessful in monitoring fidelity of presenters)
Koning et al. (2011)	Low (schools were assigned randomly to four different conditions)	Low (randomization was conducted centrally)	Unclear	Unclear	Low (86.2% participated in the 34-month follow-up)	High (self-reported data)	High (Baseline data were collected after assigning schools to conditions.)
Koutakis, Stattin, & Kerr (2008)	High (schools were not randomly selected)	Unclear	Unclear	Unclear	Low (93.3% participated at baseline, 86% at 12 month follow-up and 89.8% at 24 month follow-up.)	High (self-reported data)	Unclear
Loveland-Cherry et al. (1999)	Low (families were randomly assigned to intervention or control condition)	Unclear	Low (participants were blinded)	Unclear	High (Significant number of parents was lost to follow-up. Percentage of attrition bias is not specified in the paper.)	High (self-reported data)	Unclear

Table 4: Risk of bias assessment (Newcastle-Ottawa Quality Assessment Scale criteria)

Study	Selection				Comparability		Outcome		Quality score
	Representative-ness of exposed cohort	Selection of the non-exposed cohort from same source as exposed cohort	Ascertainment of exposure	Outcome of interest was not present at start of study	Comparability of cohorts	Assessment of outcome	Follow-up long enough for outcome to occur (median duration of follow-up ≥6 months)	Adequacy of follow- up	
Chun et al. (2008)	Participants were from ED department who had injury and reported alcohol consumption 6 hours before the ED visit.	Yes ★	Adolescents completed questionnaires at the Emergency department.	Yes ★	Confounders were not adjusted for hierarchical regression analysis.	Adolescent self-report.	No	93% participated at 3-month follow-up.★	Poor
Janssen et al. (2014)	Not representative as among the 252 participants only 81 (32.1%) were male, and 171 (67.9%) were female.	Yes ★	Adolescents participated in survey website.	Yes ★	Multinomial logistic regression. Lack of clear statement about the adjustment for confounders.	Adolescent self-report.	Yes ★	The retention rate was not clearly stated for each follow-up.	Poor
Levitt and Cooper (2015)	Not representative as black adolescents were overrepresented intentionally.	Yes ★	Adolescents participated in structured face to face interview. Drinking problems were answered in self-administered questionnaire.★	Yes ★	Gender, age, SES, familial alcohol risk, family structure, consistent parenting were adjusted for multilevel growth curve analyses.★	Adolescent self-report.	Yes ★	88% participated at 6-year follow-up, 73% at 12-year follow-up, 81% (27 years old or younger) at	Poor

								13-year follow-up and 67% (who were eligible in the previous follow-up) at 14-year follow-up. 93% (mother of adolescents who were <18 years) participated at 84-month follow-up.	
McMorris et al. (2011)	Representative samples were recruited from seventh-grade students of Victoria and Washington states of Australia and the USA respectively. ★	Yes★	Students completed questionnaires at classroom.	Yes★	Gender, age, and SES were adjusted for path models.★	Adolescent self-report.	Yes★	97% participated at 12-month follow-up and 24-month follow-up.★	Good
Nash, McQueen & Bray (2005)	Participants were truly representative as data were collected from 11 high schools in six districts of Houston area. ★	Yes★	Students completed comprehensive questionnaires.	Yes★	Structural equation models (SEM). Lack of clear statement about the adjustment for confounders.	Adolescent self-report.	Yes★	77% participated in three waves. The participation rate is not specified for each follow-up period.	Poor
Reifman et al. (1998)	Not representative as black families	Yes ★	Families completed face to face interviews at	Yes ★	Parent monitoring, reliance on	Adolescent self-report.	Yes★	The retention rate was over 90% at 12-	Fair

	was overrepresented.		their home.		friends, mother drinking, father alcohol problems and friend drinking were adjusted for logistic regression analysis.★			month and 24-month follow-up. ★	
Reimuller, Hussong& Ennett (2011)	Participants were truly representative as data were collected from all schools of three counties across the state of North Carolina.★	Yes★	Adolescents completed questionnaires at classroom and parents completed telephone survey.	Yes★	Hierarchical linear model. Lack of clear statement about the adjustment for confounders.	Adolescent self-report.	Yes★	100% adolescents participated at 6 month follow-up, 82.8% at 12 month follow-up, 85.2% at 18 month follow-up, 80.0% at 24 month follow-up, 76.1% at 30 month follow-up and 59.6% at 36 month follow-up. 82.5% parents participated at 18 month follow-up and 71.8% at 30 month follow-up.	Poor
Stice, Barrera & Chassin (1998)	Not representative as most of the adolescents was non-Hispanic Caucasians and study was	Yes★	Adolescents and parents completed computer-assisted interviews.	Yes★	Adolescent age and parental alcoholism were adjusted for standardized path coefficient.★	Adolescent and parent self-report.	Yes★	99% participated at 12 month follow-up.★	Good

	restricted to adolescents who reported drinking alcohol during the study period.								
Strandberg et al. (2014)	40 municipal schools participated from 13 counties out of 21 Swedish counties. ★	Yes★	Parents received questionnaires by post and youth completed questionnaires in school.	Yes★	Multilevel logistic regression. Lack of clear statement about the adjustment for confounders.	Adolescent and parent self-report.	Yes ★	92% adolescents and 75% parents participated at the 12-month follow-up, and 88% adolescents and 68% parents participated at the 30-month follow-up.	Poor
Van den Eijnden et al. (2011)	13 high schools and 3 schools of professional education participated.★	Yes ★	Adolescents completed questionnaires at classroom.	Yes ★	Income of family, adolescent gender, age, ethnicity, education level was adjusted for longitudinal model.★	Adolescent self-report.	Yes ★	67% participated at 24-month follow-up.	Poor

★: A maximum of one star is allocated for each domain within the 'Selection' and 'Outcome' categories; and a maximum of two stars is allocated for 'Comparability'.
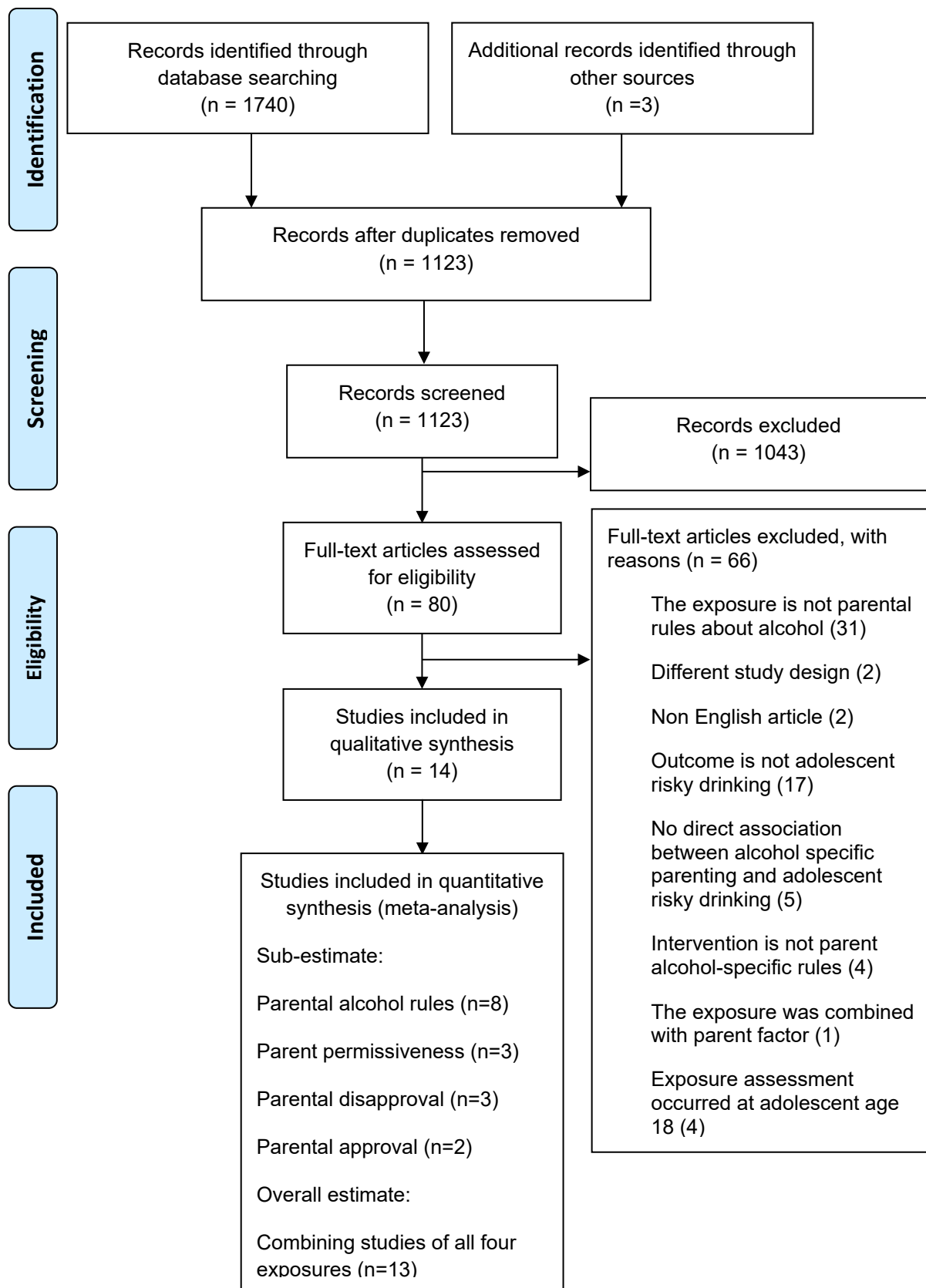
Identification

Records identified through database searching
(n = 1740)

Additional records identified through other sources
(n =3)

Records after duplicates removed
(n = 1123)

Screening

Records screened
(n = 1123)

Records excluded
(n = 1043)

Eligibility

Full-text articles assessed for eligibility
(n = 80)

Full-text articles excluded, with reasons (n = 66)

The exposure is not parental rules about alcohol (31)

Different study design (2)

Non English article (2)

Outcome is not adolescent risky drinking (17)

No direct association between alcohol specific parenting and adolescent risky drinking (5)

Intervention is not parent alcohol-specific rules (4)

The exposure was combined with parent factor (1)

Exposure assessment occurred at adolescent age 18 (4)

Studies included in qualitative synthesis
(n = 14)

Included

Studies included in quantitative synthesis (meta-analysis)

Sub-estimate:

Parental alcohol rules (n=8)

Parent permissiveness (n=3)

Parental disapproval (n=3)

Parental approval (n=2)

Overall estimate:

Combining studies of all four exposures (n=13)

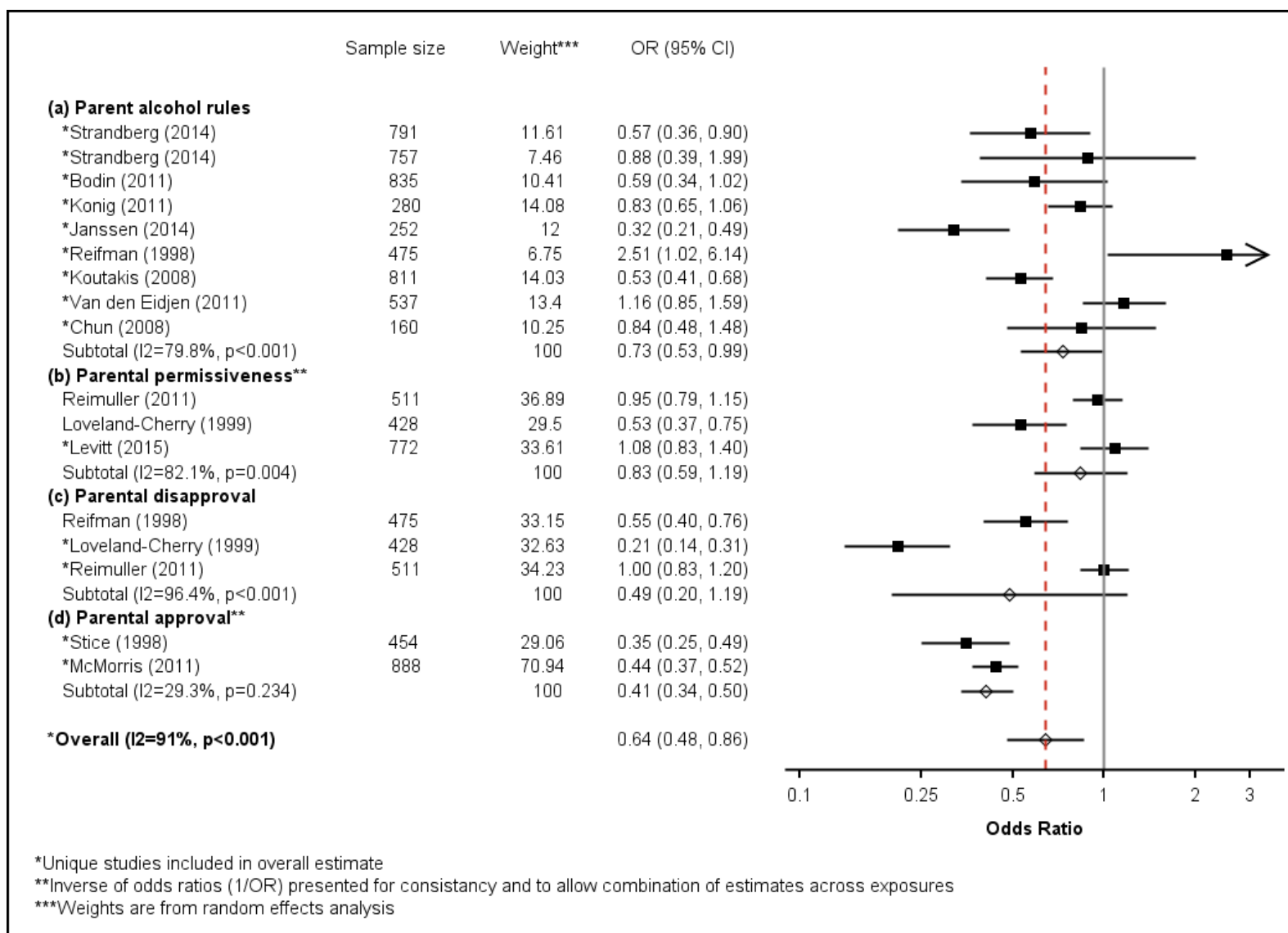Figure 1: Flow diagram outlining search results

Figure 2: Parental rules and adolescent risky drinking

Appendix Table 1. Search strategy used for PsycINFO

A. Parent Rules	B. Adolescent Risky Drinking	C. Study Design
1. Parents/ or Parenting/ or Child Rearing/ or Parent-Child Relations/ (56137)	6. early adult.mp. (604) 7. "child*".mp. (614843) 8.exp offspring/(13602) 9. "adolescen*".mp. (211062) 10. famil*.mp. (363530) 11. juvenil*.mp.(30868) 12. progeny.mp. (1010) 13. "girl*".mp. (59938) 14. "boy*".mp. (65015) 15. "teenage*".mp. (11573) 16. "young adult*".mp. (34805) 17. youth.mp. (66872) 18. "pubescen*".mp. (414) 19. high school.mp. (76198) 20. "teen*".mp. (18401) 21. young women.mp. (5822) 22. young men.mp. (4271) 23. "young male*".mp. (2898) 24. "young female*".mp. (1530) 25. student*.mp. (529793) 26. young people.mp. (19942) 27. "minor*".mp.(60897) 28. "kid*".mp. (11625) 29. "underage*".mp. (972) 30. "puber*".mp. (6915) 31. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30(1428037)	42. Cohort Study.mp. (11053) 43. prospective stud*.mp. (11954) 44. longitudinal stud*.mp. (45782) 45. retrospective study.mp. (4104) 46. random*.tw (149685) 47. Clinical Trials/ (9232) 48. 42 or 43 or 44 or 45 or 46 or 47 (223471)
2. expparent child communication/ (5998)	32. risky drinking.mp. (374) 33. heavy drinking.mp. (3113) 34. hazardous drinking.mp. (519) 35. Binge drinking.mp. (2922) 36. heavy episodic drinking.mp. (454) 37. problem drinking.mp. (2069) 38. exp alcohol abuse/ (41250) 39. excessive drinking.mp. (719) 40. 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 (44666) 41. 31 and 40(16117)	
3. Alcohol specific parenting.mp. (24) 4. ((parent* or mother* or father* or maternal* or guardian* or custodian*) adj5 (rule* OR support* OR control* OR supervis* OR unsupervis*		

OR approv* OR surveillance*
OR attitude* OR influenc* OR
monitor* OR permissive* OR
behavior* OR
behaviour*)).mp.(91622)
5. 1 or 2 or 3 or 4
(130142)
49. A (5) and B (41) and C (48) = 208

Appendix Table 2: Sensitivity analyses of the pooled estimate of parental rules concerning alcohol use

Studies for sensitivity analysis	No. of studies (no. of estimates)	OR	95% CI (lower, upper limit)	*p* for heterogeneity (*I*^{2} (%))
Excluding studies of parental alcohol rules	5 (5)	0.52	0.30, 0.89	<0.001 *(96.0)*
Excluding studies of parental permissiveness of alcohol use	12 (13)	0.62	0.46, 0.83	<0.001 *(90.5)*
Excluding studies of parental disapproval of alcohol use	11 (12)	0.68	0.51, 0.89	<0.001 *(87.5)*
Excluding studies of parental approval of alcohol use	11 (12)	0.71	0.52, 0.96	<0.001 *(89.1)*
Excluding randomized trials	5 (6)	0.73	0.51, 1.03	<0.001 (91.2)
Excluding prospective studies	4 (4)	0.49	0.28, 0.85	<0.001 (91.5)
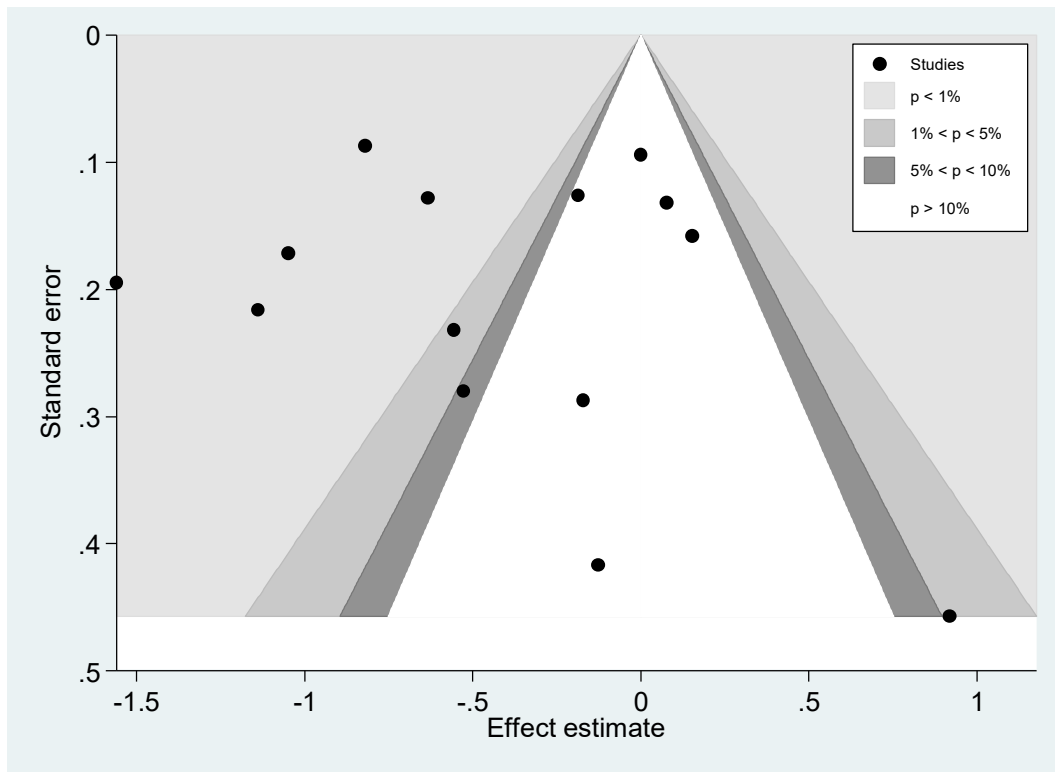
Appendix Figure 1: Contour-enhanced funnel plot of studies on the association between parental rules and adolescent risky drinking

PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2-3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	5-6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	7
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6, 30
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6-7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	47-48
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6-9

Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	7-8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6, 30
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7-8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	9
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	8-9
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	9
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	9
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	9-10, 45
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	10-12, 31-39
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	15-18, 40-44
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	12-15, 18-19, 46
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	18-19, 46
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	19, 50

Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	19, 49
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	20-23
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	23
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-