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Can Motivational Interviewing in Emergency Care Reduce Alcohol Consumption in Young People? A Systematic Review and Meta-analysis

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Abstract — **Aims:** We investigate the effect of motivational interviewing (MI), delivered in a brief intervention during an emergency care contact, on the alcohol consumption of young people who screen positively for present or previous risky alcohol consumption. **Methods:** MEDLINE, CINAHL, EMBASE, PsycARTICLES, PsycINFO, PSYNDEX and Scopus were searched for randomized controlled trials with adolescents or young adults that compared MI in an emergency care setting to control conditions and measured drinking outcomes. **Results:** Six trials with 1433 participants, aged 13–25 years, were included in the systematic review and meta-analysis. MI was never less efficacious than a control intervention. Two trials found significantly more reduction in one or more measures of alcohol consumption in the MI intervention group. One trial indicated that MI may be used most effectively in young people with high-volume alcohol consumption. Separate random effects meta-analyses were performed based on the highest impact that MI added on reducing the drinking frequency and the drinking quantity at any point in time during the different study periods. Their results were expressed as standardized mean differences (SMDs). The frequency of drinking alcohol decreased significantly more after MI than after control interventions (SMD ≤ −0.17, $P \leq 0.03$). In addition, MI reduced the drinking quantity further than control interventions in a meta-analysis of the subset of trials that were implemented in the USA (SMD = −0.12, $P = 0.04$). Meta-analyses of the smallest mean differences between MI and control groups detected no differences in alcohol use (SMD ≤ 0.02, $P \geq 0.38$). **Conclusion:** MI appears at least as effective and may possibly be more effective than other brief interventions in emergency care to reduce alcohol consumption in young people.

INTRODUCTION

Binge drinking or heavy episodic drinking is a global health problem among young people, which varies widely between countries. The WHO recently published global data for the year 2010. The worldwide highest binge drinking rates among 15- to 19-year-olds occurred in European countries and Canada, where ≥30% of this age group drink 60 or more grams of pure alcohol on at least one single occasion at least monthly (WHO, 2014). In the USA and Brazil, the binge drinking prevalence in this age group was 10–20% and 20–30%, respectively. The younger people start consuming alcohol, the higher are their risks to drink regularly, to develop an addiction, and to suffer or die from alcohol-related illnesses (Grant and Dawson, 1998). In Germany, for instance, one of the high alcohol consumption countries, 15,680 young people aged 25–35 years and 35,386 young people aged 15–25 years were hospitalized due to alcohol intoxication in 2012. This was ~1 in every 250 young adults in the younger age group, and twice as many alcohol-related hospitalizations among 15- to 35-year-olds than a decade ago (Federal Statistical Office of Germany, 2014a,b).

The admission to hospital after an excessive spree has been considered a *window of opportunity* to offer secondary prevention methods (Spirito *et al.*, 2004). Being admitted to the hospital, amongst other factors, was associated with a greater intention to change drinking at the time of the event (Barnett *et al.*, 2002). Some interventions to reduce alcohol-related harms therefore apply motivational interviewing (MI) techniques to offer secondary prevention to hospitalized young people who screen positive for risky alcohol consumption in an emergency care setting (Hofmann and Kohler, 2013). MI is based on the assumption that facilitating and engaging intrinsic motivation is essential for behavioural change. Its central purpose is the examination and resolution of ambivalence. The counsellor is intentionally directive in pursuing this goal. MI is more focused and goal-directed than nondirective counselling (Miller and Rose, 2009; Rollnick and Miller, 2009).

Several systematic reviews have recently discussed the efficacy of MI in medical settings, some of which with a focus on young people, and concluded differently: Most youth reduced alcohol use, regardless of the form of care received during an intervention. Consequently, clear benefits of using MI in emergency care to reduce alcohol or other drug use, and associated injuries or high-risk behaviours remain inconclusive (Yuma-Guerrero *et al.*, 2012; Newton *et al.*, 2013). MI in various inpatient and outpatient settings appears to be modestly advantageous over comparison interventions with particular promise in areas like alcohol and tobacco use among (Lundahl *et al.*, 2013). MI in emergency departments that targeted alcohol problems can reduce alcohol consumption or alcohol-related injuries of adults (D'Onofrio and Degutis, 2002; Havard *et al.*, 2008; Nilsen *et al.*, 2008). Brief interventions with adolescents, in which MI was the predominant approach, were effective in reducing alcohol consumption and related harm (Patton *et al.*, 2014) or alcohol consumption and other drug use (Tait and Hulse, 2003).

We conducted a systematic review and meta-analyses to examine changes in alcohol consumption after brief motivational interventions for young people with existing alcohol use problems, who were admitted to an emergency care unit alcohol positive, with an alcohol-related trauma, or with a history of elevated alcohol consumption.

METHODS

We followed the PRISMA guidelines in conducting this study.

Search strategy

The following databases were searched from inception to 24 September 2013: MEDLINE through PubMed, EMBASE

through OvidSP, CINAHL, PsycARTICLES, PsycINFO, PSYNDEX through EBSCOhost, and Scopus. Search terms were ('motivational interview*' OR 'intervention*') AND ('alcohol*' OR 'drink*') AND ('trauma*' OR 'injury*' OR 'emergency*'). The applied filters were randomized controlled trial (RCT) or clinical trial and adolescent or young adult. The EMBASE search included the filter adult instead of young adult. We also performed a manual search of the references of all retrieved articles (Fig. 1).

Eligibility criteria

Studies were included in the systematic review and meta-analyses if they: evaluated MI or motivational enhancement therapy (MI plus feedback) that targeted alcohol consumption against either another or no intervention in an emergency care setting; included, at least some, young people of age 18 years or younger; employed a RCT design. Studies were excluded if they: allowed participants older than 25 years; did not report drinking outcomes; were not published in English or German in a peer-reviewed source. Studies, study arms or drinking outcome data were also excluded from our review and meta-analyses if: MI was delivered only through a computer-based program; MI was also delivered in standard care; disaggregate outcome data were not available.

Data extraction

We extracted data on the study design and population, details of the intervention, length of follow-up, attrition, drinking outcomes collected, results, and the methods employed for data collection and analysis. Extracted results included the mean and standard deviation of drinking outcomes for the MI and control groups as well as the significance of their difference at baseline and all follow-up times. The significance levels extracted for the treatment, time and interaction effects on the drinking outcomes were adjusted for covariates by most studies and, hence, do typically not correspond to the summarized means, mean differences and standard deviations of the summarized raw data used in our meta-analyses.

Study quality

We assessed the quality of the studies using the Critical Appraisal Skills Programme (CASP) RCT checklist.

Statistical analysis

Alcohol consumption data from the study arms of the trials that fulfilled our study eligibility criteria were pooled. Drinking outcomes were assessed in separate meta-analyses that assessed either drinking frequency, or drinking quantity measures. Due to different measurement scales for these outcomes across trials,

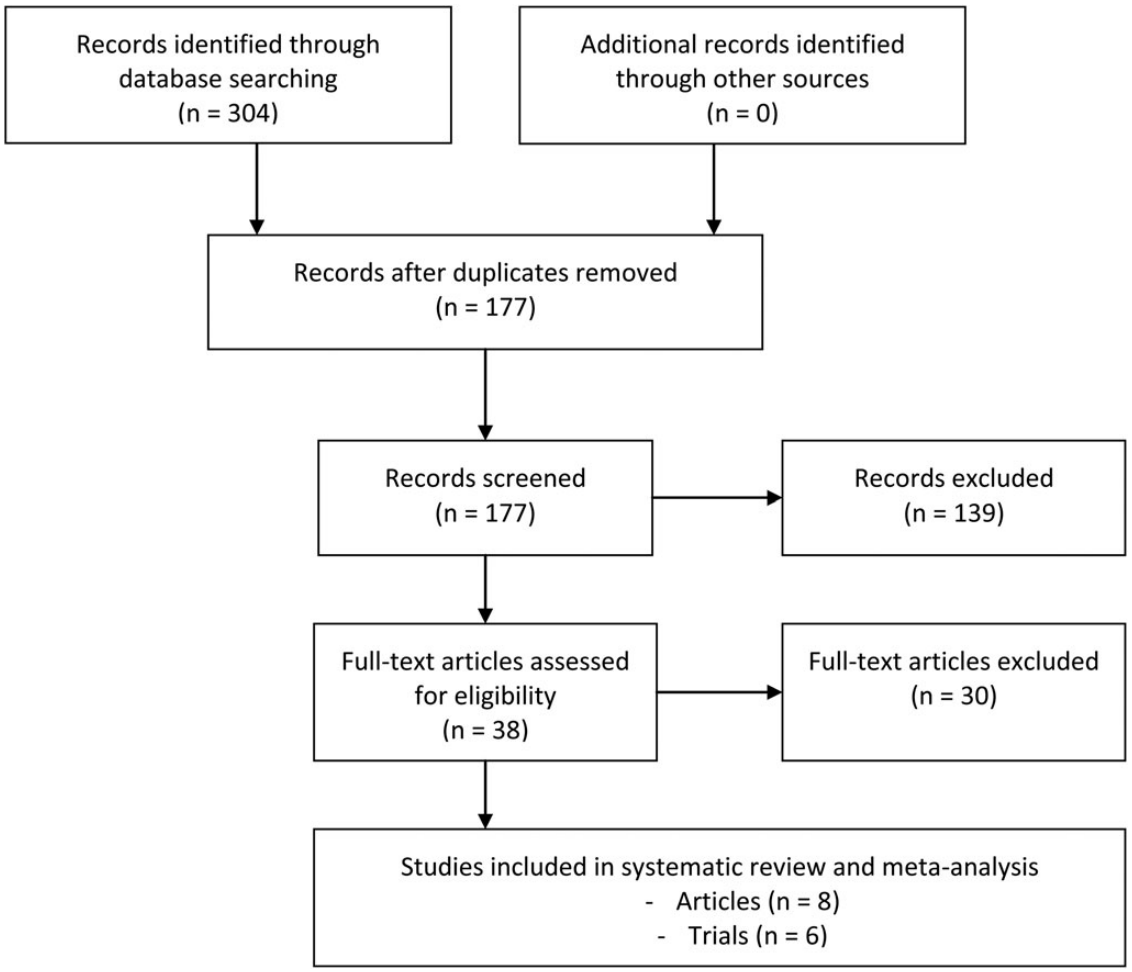


Fig. 1. Flow diagram of study selection.

effects were expressed as standardized mean differences (SMD) in the meta-analyses. The meta-analyses were performed using a random effects model to account for the heterogeneity between the trials included. The random effects model allowed for a distribution of true effect size (see, e.g. Borenstein *et al.*, 2010). Our goal was to estimate the mean of this distribution. Heterogeneity of effect sizes was assessed by using the *I-squared* value. Analyses were performed in Stata using the *metan*, *metabias* and *metafunnel* commands.

Either one drinking frequency outcome, or one drinking quantity outcome per trial was used within each analysis to meet the assumption of independence (see, e.g. Murray *et al.*, 2012). We applied the following method to select independent data: We included the data from follow-up during which MI had the strongest effect (SMD) in comparison to the control intervention if studies reported an outcome at more than one follow-up. Meta-analyses of the weakest effects of MI in comparison to the control intervention were performed in addition to establish a lower confidence bound of the SMD.

If a study reported more than one drinking quantity variable, the measure most comparable across studies was included in the meta-analysis (Monti *et al.*, 1999; Bernstein *et al.*, 2010). For one trial, the drinking quantity and its standard error were calculated based on the published frequency of light, moderate and heavy alcohol use (Segatto *et al.*, 2011). For two trials in which pertinent outcomes were not reported, the corresponding authors provided the data upon request (Monti *et al.*, 1999; Cunningham *et al.*, 2009).

Publication bias of the enclosed literature was assessed based on funnel plots and Egger's test for small-study effects.

RESULTS

Study characteristics

Our selection criteria yielded six study arms from six RCTs (Monti *et al.*, 1999, 2007; Spirito *et al.*, 2004; Cunningham *et al.*, 2009; Bernstein *et al.*, 2010; Segatto *et al.*, 2011). For one trial, three separate studies describe the results from the follow-ups after 3, 6 and 12 months (Cunningham *et al.*, 2009, 2012; Walton *et al.*, 2010). We refer to this trial using its first publication by Cunningham *et al.* (2009). All trials implemented MI in the setting of an emergency department; five in the USA and one in Brazil. There were 1433 participants across the six study arms reviewed and included in the meta-analysis. Sample size varied from 94 to 567 participants. The age of the participants ranged from 13 to 25 years. The share of females was between 9.7 and 67.8%. Participants were followed-up after a minimum of 3 or 6 months, and a maximum of 6 or 12 months. The follow-up rates at completion varied from 69.4 to 93.4%. Alcohol consumption patterns were either collected over 30 days, 3 months, or an unspecific time period (Table 1).

Two study arms from two trials were excluded from the review and meta-analyses. One of them assessed a computerized brief intervention in a three arm trial (Cunningham *et al.*, 2009). The other excluded study arm was a minimally assessed control group, for which drinking outcome data were not reported (Bernstein *et al.*, 2010).

Intervention characteristics

The studied brief interventions aimed at reducing alcohol consumption and associated risks or problems, like drunk driving, violence or alcohol-related injuries. Interventions lasted from 5 to 45 min and were usually longer than 20 min, or had a median length of 37 min. The target group was young people in emergency care who screened positively for past or present risky alcohol consumption. To determine eligibility for a brief intervention, studies screened for hazardous drinking in form of self-reported alcohol consumption, blood alcohol concentration, alcohol in saliva or breath, high-risk behaviour in conjunction with alcohol use, or a combination of these.

Control interventions, or standard care, included written information (e.g. alcohol-use risk handout, educational brochure), a contact list (e.g. community resources, adolescent treatment facilities), a phone follow-up, or personal feedback. MI interventions included a treatment more or less similar to the control intervention plus MI. One trial combined MI with normative resetting and skills training (Cunningham *et al.*, 2009). In two trials, the MI groups also received additional 'booster' phone calls after 10 days, or after 1 and 3 months that were not part of the control interventions (Monti *et al.*,

Table 1. Study characteristics

Study	Country	*N*	Age (years)	Female (%)	Study arms	Intervention duration (min)	Data collection methods	Alcohol report	Follow-up (months)	Follow-up rates (%)
Bernstein *et al.* (2010)	USA	567	14–21	54.5	3[a]	20–30	Self-report, screening, motor vehicle record, medical record	30 days	3, 12	I: 71.4, 73.1 C: 69.4, 73.6
Cunningham *et al.* (2009)	USA	489	14–18	56.5	3[a]	37[b]	Audio computer-assisted self-interviewing	3 months	3, 6, 12	I: 85, 82, 80.3 C: 88, 89, 86.0
Monti *et al.* (1999)	USA	94	18–19	35.1	2	35–40	Self-report, motor vehicle record	3 months	3, 6	93, 89
Monti *et al.* (2007)	USA	198	18–24	67.8	2	30–45	Self-report, motor vehicle record, BAC	30 days	6, 12	I: 81, 80 C: 86, 83
Segatto *et al.* (2011)	Brazil	175	16–25	9.7	2	5–45	Self-report	3 months	3	I: 85.1 C: 85.2
Spirito *et al.* (2004)	USA	152	13–17	36.2	2	35–45	Self-report, parents, BAC	3 months	3, 6, 12	93.4, 89.5, 89.5

BAC, blood alcohol concentration; C, control group; I, intervention group.
[a]One study arm excluded from systematic review and meta-analysis.
[b]Median.

2007; Bernstein *et al.*, 2010) (Table 2). Interventions details are described in the Supplementary Table S1.

Drinking outcomes

A variety of different self-reported outcomes were used to measure alcohol consumption (Table 3). Studies originally reported between two and four drinking outcomes that can be categorized as either quantity or frequency measures, or a combination thereof. Four studies reported the quantity of alcohol as actual or average drinks/units consumed within a given time frame (Monti *et al.*, 1999, 2007; Spirito *et al.*, 2004; Bernstein *et al.*, 2010). Also four studies reported the frequency of drinking days or episodes within a given time frame (Monti *et al.*, 1999; Spirito *et al.*, 2004; Bernstein *et al.*, 2010; Segatto *et al.*, 2011). The three related studies of the same trial reported an *Alcohol Use Disorders Identification Test-Consumption (AUDIT-C)* cut-off score, which is a combined measure of the drinking frequency and quantity (Cunningham *et al.*, 2009). Four trials included a separate measures for the frequency of heavy drinking (Spirito *et al.*, 2004; Monti *et al.*, 2007; Cunningham *et al.*, 2009; Segatto *et al.*, 2011). One study asked about moderate and low drinking days in addition (Segatto *et al.*, 2011).

Baseline differences

Several sociodemographic baseline characteristics and baseline alcohol use measures were balanced in five of the six study arms included in the review and meta-analyses. In two trials, also measures of alcohol-related risks were balanced at the baseline ($P > 0.05$, Table 4). In the Bernstein *et al.* (2010) trial, age, sex, race, primary language, baseline AUDIT score by age group, and consumption variables were similar, but the control group had a higher rate of driving after drinking ($P < 0.05$). In the Cunningham *et al.* (2009) trial, age, gender, race, school dropout, reason for the emergency department (ED) visit, past-year substance abuse as well as violence, family public assistance, failing grades, live with parents and gang involvement were similar between the randomized groups at the start of the trial. In the Monti *et al.* (1999) trial, age, gender, ethnicity, number of years in school, school status, reason for the ED visit, BAC, drinking behaviour and the severity of alcohol involvement, measured by the Adolescent Drinking Inventory, were similar. In the Monti *et al.* (2007) trial, age, gender, ethnicity, BAC and reasons for treatment were similar, but the control group had more years of school ($P < 0.01$). In the Segatto *et al.* (2011) trial, age, gender, ethnicity ($P = 0.09$), marital status, school status, reason for the ED visit, various measures of alcohol abuse and consumption patterns were similar, but the MI group had more risks associated with alcohol abuse according to an index calculated from an *Alcohol Consumption Risk Questionnaire* ($P = 0.05$). In the Spirito *et al.* (2004) trial, there were no baseline differences between the MI and control groups' sex, race, school status, reason for the ED visit, blood alcohol concentration as well as self-reported alcohol consumption, drinking and driving, and the severity of alcohol involvement. An imbalance in age across conditions was noted by Spirito *et al.* (2004) in the last year of recruitment, and it was corrected prior to the end of the trial through stratifying participants by age in the trial's final year.

Table 2. Intervention characteristics

Study	Intervention and control group treatment	Targeted group	Eligibility	Place and/or timing
Bernstein *et al.* (2010)	I: MI and 'booster' phone call, referrals to youth oriented services or treatment C: Alcohol-use risk handout, 2 appointments for reassessment	Paediatric ED patients including noninjured and nonintoxicated, ethnically diverse	Binge drinking, high-risk behaviours in conjunction with alcohol use, and/or AUDIT ≥ 4 for ages 14–17 years or ≥8 for ages 18–21 years	In paediatric ED
Cunningham *et al.* (2009)	I: MI, normative resetting, skills training, contact list C: Written information, contact list	ED patients reporting past-year alcohol use and aggression	Self-report of aggressive behaviour and alcohol consumption in past year	During ED visit
Monti *et al.* (1999)	I: MI plus C C: Written information, contact list	ED patients following an alcohol-related event	BAC+, report of drinking alcohol prior to hospitalization	In ED during or after patient's treatment
Monti *et al.* (2007)	I: MI and 'booster' phone calls plus C C: Personal feedback, written information, contact list, phone follow-up	ED patients who were alcohol positive upon hospital admission or met screening criteria	AUDIT+, BAC+, self-report of drinking alcohol prior to hospitalization	Delivered in the ED
Segatto *et al.* (2011)	I: MI plus C C: Educational brochure, short discussion with psychologist about brochure	Patients of 3 EDs treated for alcohol-related events up to 6 h after consumption	Screening questionnaire assessed alcohol consumption within 6 h prior to ED visit	At different times from ED admission, patients no longer under the influence of alcohol
Spirito *et al.* (2004)	I: MI, written information, contact list C: Short consultation, written information, contact list	ED patients treated after an alcohol-related event	BAC > 0.1, alcohol+ saliva or breath, self-report of drinking alcohol prior to hospitalization (ADI ≥15)	If unable to complete participation during ED visit, scheduled to return to hospital within a few days

ADI, Adolescent Drinking Index; AUDIT, Alcohol Use Disorders Identification Test; BAC, blood alcohol concentration; C, control group; ED, emergency department; I, intervention group; MI, motivational interviewing; +, positive.

Table 3. Drinking outcomes

Drinking outcome	Time	MI group *N*	MI group MN	MI group SD	MI group Diff.	Control group *N*	Control group MN	Control group SD	Control group Diff.	Mean diff.	*P*-value for effect: Treatment	*P*-value for effect: Time	*P*-value for effect: Interaction
Bernstein *et al.* (2010)													
Drinking days per month	0	207	6.7	4.5		209	6.6	4.5		0.1	0.848		
	3+	202	5.5	4.5	−1.2	202	5.7	4.5	−0.9	−0.2	0.777	NA	NA
	12−	207	4.9	4.5	−1.8	209	5.1	4.5	−1.5	−0.2	0.752	0.877	0.866
Mean drinks per week	0	207	9.1	9.1		209	7.7	9.1		1.4	0.17		
	3−	202	7.6	9.1	−1.5	202	6.9	9.1	−0.8	0.7	0.503	NA	NA
	12+	207	5.5	9.1	−3.6	209	5.6	9.1	−2.1	−0.1	0.913	0.369	0.449
Mean drinks per drinking day	0	207	5.0	2.7		209	4.6	2.7		0.4	0.165		
	3	202	4.3	2.7	−0.7	202	4.0	2.7	−0.6	0.3	0.336	NA	NA
	12	207	3.5	2.7	−1.5	209	3.5	2.7	−1.1	0.0	0.992	0.297	0.480
Maximum drinks per day	0	207	7.8	4.4		209	7.5	4.4		0.3	0.656		
	3	202	6.3	4.4	−1.5	202	6.1	4.4	−1.4	0.2	0.722	NA	NA
	12	207	5.2	4.4	−2.6	209	5.7	4.4	−1.8	−0.5	0.314	0.974	0.343
Cunningham *et al.* (2009)													
AUDIT-C score for drinking frequency[a]	0	254	1.7	0.9		235	1.7	0.9		0.0			
	3	215	1.1	1.2	−0.6	206	1.2	1.3	−0.5	−0.1	NA	NA	NA
	6+	209	0.9	1.3	−0.8	208	1.1	1.2	−0.6	−0.2	NA	NA	NA
	12−	204	1.0	1.2	−0.7	202	1.0	1.2	−0.7	0.0	NA	NA	NA
AUDIT-C score for drinking quantity[a]	0	254	1.8	1.2		235	1.8	1.3		0.0			
	3	215	1.2	1.5	−0.6	206	1.3	1.5	−0.5	−0.1	NA	NA	NA
	6+	209	1.0	1.5	−0.8	208	1.2	1.5	−0.6	−0.2	NA	NA	NA
	12−	204	1.2	1.5	−0.6	202	1.2	1.6	−0.6	0.0	NA	NA	NA
Alcohol misuse: AUDIT-C ≥ 3	0	254	0.50	NA		235	0.48	NA		0.02			
	3	215	0.34	NA	−0.16	206	0.38	NA	−0.10	−0.04	0.61	0.01	0.26
	6	209	0.33	NA	−0.17	208	0.35	NA	−0.13	−0.02	0.61	0.001	0.42
	12	204	0.37	NA	−0.13	202	0.36	NA	−0.12	0.01	0.61	<0.01	0.98
Any binge drinking	0	254	0.53	NA		235	0.54	NA		−0.01			
	3	215	0.34	NA	−0.18	206	0.35	NA	−0.19	0.00	0.78	<0.001	0.89
	6	209	0.33	NA	−0.20	208	0.34	NA	−0.20	−0.02	0.78	<0.001	0.93
	12	204	0.39	NA	−0.14	202	0.35	NA	−0.19	0.04	0.77	<0.001	0.55
Monti *et al.* (1999)													
No. of days drinking per month[a]	0	52	7.84	8.07		42	8.24	7.60		−0.40			
	3+	48	5.48	6.40	−2.36	39	7.82	5.83	−0.42	−2.34	NA	NA	NA
	6−	45	7.35	6.55	−0.49	39	7.41	7.15	−0.83	−0.06			
No. of drinks per episode[a]	0	52	5.65	2.00		42	4.98	1.75		0.67			
	3+	47	3.87	2.65	−1.78	39	4.28	2.46	−0.70	−0.41	NA	NA	NA
	6−	45	4.40	2.55	−1.25	39	4.62	2.29	−0.36	−0.22			
Average daily quantity[a]	0	52	1.64	2.06		42	1.36	1.33		0.28			
	3	47	1.05	1.57	−0.59	39	1.35	1.14	−0.01	−0.30	NS	<0.001	NS
	6	45	1.34	1.35	−0.29	39	1.44	1.78	0.08	−0.10			
Monti *et al.* (2007)													
No. of days drinking past month	0	78	8.27	6.35		83	7.31	6.27		0.96	NS		
	6−		4.73	5.64	−3.54		6.19	6.58	−1.12	−1.46	NS	<0.001	<0.01
	12+		4.52	5.70	−3.75		6.54	6.24	−0.77	−2.02	NS	<0.001	<0.001
Avg. no. of drinks per week past month	0		13.07	11.95			10.77	10.73		1.48	NS		
	6−		6.63	9.22	−6.44		9.20	12.16	−1.57	−0.77	NS	<0.001	<0.01
	12+		6.10	8.33	−6.97		8.83	9.67	−1.94	−0.81	NS	<0.001	<0.01
No. of heavy drinking days past month	0		5.49	5.94			4.01	4.48		2.30	NS		
	6		2.87	4.77	−2.62		3.64	4.47	−0.37	−2.57	NS	<0.001	<0.01
	12		2.72	4.70	−2.77		3.53	4.28	−0.48	−2.73	NS	<0.001	<0.01
Segatto *et al.* (2011)													
Days of alcohol use in 3 months	0	74	23.3	21.9		75	22.4	22.4		0.9			
	3+,−		14.0	18.5	−9.3		11.8	15.3	−10.6	2.2	0.54	<0.01	0.75
Units in 3 months[b]	0		203.6	260.8			181.0	241.7		22.6			
	3+,−		119.7	184.2	−83.9		85.7	121.2	−95.3	34.0	NA	NA	NA
Days of light use in 3 months	0		4.0	12.0			3.6	10.3		0.4			
	3		3.5	9.6	−0.5		3.8	11.9	0.2	−0.3	0.98	0.93	0.78
Days of moderate use in 3 months	0		8.9	15.2			8.5	14.6		0.4			
	3		3.7	10.4	−5.2		4.1	8.8	−4.4	−0.4	0.97	<0.01	0.78
Days of heavy use in 3 months	0		10.5	18.9			9.0	17.4		1.5			
	3		6.8	13.4	−3.7		3.8	8.0	−5.2	3.0	0.24	<0.01	0.63
Spirito *et al.* (2004)													
Drinking days per month	0	64	3.53	4.67		60	4.18	4.97		−0.65			
	3		2.55	4.06	−0.98		3.54	5.39	−0.64	−0.99			
	6−		3.79	4.64	0.26		3.91	5.47	−0.27	−0.12	NS, <0.05 if ADI ≥ 15[c]	NS	NS
	12+		2.88	4.04	−0.65		5.01	6.11	0.83	−2.13			

Continued

Table 3. *Continued*

Drinking outcome	Time	MI group N	MI group MN	MI group SD	MI group Diff.	Control group N	Control group MN	Control group SD	Control group Diff.	Mean diff.	*P*-value for effect: Treatment	*P*-value for effect: Time	*P*-value for effect: Interaction
Standard drinks per occasion	0		4.53	2.04			4.77	2.31		−0.24			
	3[+]		2.61	2.53	−1.92		3.17	3.09	−1.60	−0.56			
	6[−]		3.39	2.60	−1.14		3.25	2.98	−1.52	0.14	NS	<0.001	NS
	12		3.56	2.54	−0.97		3.67	2.77	−1.10	−0.11			
High-volume drinking days per month	0		1.82	3.46			2.59	4.01		−0.77			
	3		1.00	2.08	−0.82		2.06	3.75	−0.53	−1.06			
	6		2.12	3.97	0.30		2.56	4.49	−0.03	−0.44	NS, <0.05 if ADI ≥ 15[c]	NS	NS
	12		1.66	2.85	−0.16		3.11	4.74	0.52	−1.45			

Interaction column reports the interaction of the treatment and time effects. Reported *P*-values for the treatment, time and interaction effects usually stem from models in the original studies that adjusted for covariates. Thus, the reported *P*-values do typically not correspond to the tabulated means, mean differences and standard deviations of the raw data. For Cunningham *et al.* (2009), the *P*-value for the time is estimated with data from both control groups, including an additional study arm. For Segatto *et al.* (2011), the units drank in 3 months were imputed based on days of use.

AUDIT-C, Alcohol Use Disorders Identification Test-Consumption; Diff., difference in mean of outcome between follow-up time and baseline; Mean diff., difference in mean of outcome between MI and control groups; NA, not available; NS, not significant and significance level not reported.

[+/−] indicates inclusion in meta-analysis as largest/smallest mean difference between motivational interviewing and control intervention during follow-up.

[a]Data kindly provided by authors upon request.

[b]Computed based on light, moderate and heavy use data.

[c]The interaction between scoring ≥15 index points on the Adolescent Drinking Index (ADI) and treatment was significant at follow-up ($P < 0.05$).

These reported baseline assessments notwithstanding, the drinking frequency (SMD = 0.01, $P > 0.81$) and the drinking quantity (SMD = 0.09, $P > 0.31$) of the MI and control groups were statistically indistinguishable in meta-analyses of the drinking outcomes at baseline.

Quality of included studies

The quality of included studies was evaluated using the CASP checklist for RCTs (Table 4). The quality of the six RCTs included was poor to good. All studies addressed a clearly focused question and described their context and the eligibility criteria for the participants. Randomization of the participants into two or three study arms was carried out in all of the trials. The randomization method used was not explained in one study (Monti *et al.*, 1999). Intervening with MI rendered comprehensive blinding impossible, but four trials reported research assistants collecting data were blind (Monti *et al.*, 2007; Cunningham *et al.*, 2009; Bernstein *et al.*, 2010; Spirito *et al.*, 2011). One study states that patients were blinded (Segatto *et al.*, 2011), but, as in the other trials, patients can infer their treatment status from the distinguishable interventions. One trials showed sociodemographic differences between the groups at the beginning (Monti *et al.*, 2007). In two trials, the young patients were treated not only with MI but also with 'booster' phone calls that the control group did not receive (Monti *et al.*, 2007; Bernstein *et al.*, 2010). A further trial combined MI with normative resetting and skills training, not received by the control group (Cunningham *et al.*, 2009). Patient follow-up and losses were explained in detail for two trials (Cunningham *et al.*, 2009; Segatto *et al.*, 2011). Dropouts were characterized in three studies (Monti *et al.*, 1999, 2007; Spirito *et al.*, 2004), and included in the analysis of two trials (Cunningham *et al.*, 2009; Bernstein *et al.*, 2010). Statistical power was discussed in the studies of two trials (Cunningham *et al.*, 2009; Bernstein *et al.*, 2010). An intention-to-treat analysis was reported or apparent from participant numbers described for the analyses in four studies (Monti *et al.*, 1999, 2007; Cunningham *et al.*, 2009; Bernstein *et al.*, 2010) and confirmed by the authors of a further study (Spirito *et al.*, 2004). Results were not analysed based on the initial treatment in one study (Segatto *et al.*, 2011). The follow-up rates, which ranged from 69.4 to 93.4%, indicate that attrition is a moderate to severe limitation to all studies (Table 1). Some studies adjusted for attrition and baseline differences in their analyses of drinking outcomes (Cunningham *et al.*, 2009) or attempts to quit drinking (Bernstein *et al.*, 2010), but the unadjusted raw data of the trials were used in our meta-analyses.

Systematic review of effects

In one trial, neither the drinking frequency nor the drinking quantity changed significantly for up to 1 year after the brief intervention during an alcohol-related emergency hospitalization, regardless of the type of intervention used ($P > 0.05$) (Bernstein *et al.*, 2010). Five RCTs found that young people consumed less alcohol after a hospital stay and brief intervention, regardless of whether MI was used in the intervention or not ($P \leq 0.01$). Based on the raw data summarized in Table 3, half of the trials observed some of the lowest amount of drinking at the initial follow-ups after 3 or 6 months, and rising consumption levels afterwards (Monti *et al.*, 1999; Spirito *et al.*, 2004; Cunningham *et al.*, 2009). In four trials, some of the least frequent drinking occurred as well before the end of the study (Monti *et al.*, 1999, 2007; Spirito *et al.*, 2004; Cunningham *et al.*, 2009) (Supplementary Fig. S1). However, *t*-tests of the equality of the tabulated group means only indicate a significant difference in the mean drinking quantity between the follow-ups after 3 and 12 months in the Spirito *et al.* (2004) trial ($P < 0.04$).

Studying moderators of the treatment effect, one trial found that MI reduced alcohol consumption more than a short consultation and written information in the subgroup of young patients with a high *Adolescent Drinking Index* score: Those who reached the clinical cut-off for referral for alcohol problems (≥15 index points) at baseline mentioned significantly fewer drinking days and high-volume drinking

days per month at follow-up ($P < 0.05$) (Spirito *et al.*, 2004). In another trial, the time-treatment interaction was significant. This indicates that the reduction in alcohol consumption over time with respect to the baseline level was stronger in the MI group than in the control group: MI participants drank on fewer days, had fewer heavy drinking days and drank fewer drinks per week than did control patients at the 6 and 12 months follow-up after accounting for possible baseline differences in these variables, which may have existed despite randomization into the intervention groups ($P < 0.01$) (Monti *et al.*, 2007). Time–treatment interactions in the other trials were insignificant.

Meta-analyses of effects

The average effect of comparable MI interventions was assessed in terms of a SMD between MI and control group outcomes. The SMD was estimated in separate meta-analyses for the drinking frequency and drinking quantity. A negative SMD implies that MI triggered a higher reduction in alcohol consumption than the control intervention. The estimated SMD varied by the type of drinking outcome studied.

MI reduced alcohol consumption at least as much as a control intervention. Analysing largest mean differences in the drinking behaviour, the frequency of drinking was significantly lower in the MI groups (SMD = −0.17, $P = 0.03$). MI showed no advantage over control interventions in terms of reducing the drinking quantity in the meta-analysis (SMD = −0.09, $P = 0.18$). Excluding the RCT from Brazil, which caused a substantial fraction of the heterogeneity in the data, and analysing only the data from trials in the USA indicates that MI is more efficacious than other interventions in reducing drinking frequency (SMD = −0.21, $P < 0.01$) and drinking quantity (SMD = −0.12, $P = 0.04$) (Fig. 2). Similar meta-analyses of the weakest effects of MI in comparison to the control intervention indicated no difference in drinking behaviour (SMD ≤ 0.02, $P \geq 0.38$) (Fig. 3).

Heterogeneity across the studies in the meta-analyses was quantified using the *I-squared* statistic (Higgins and Thompson, 2002). The *I-squared* values of ≤42% for the drinking frequency and ≤24% for the drinking quantity describe the percentage of the variation in the SMDs attributable to heterogeneity rather than chance. Excluding the only trial that was conducted outside the USA reduced the heterogeneity to ≤25% and 0%, respectively.

Risk of publication bias

We investigated the risk of publication bias for the meta-analyses that included the strongest MI effects using funnel plots (Fig. 4). Egger's test is used to test for funnel plot asymmetry, which, among other things, can be caused by selective outcome reporting or publication bias. No evidence of funnel plot asymmetry was detected by Egger's test for the mean differences of the drinking frequency ($P = 0.35$) and quantity ($P = 0.79$) outcomes of the published USA and Brazil trials. For the US trials only, Egger's test indicates that publication bias may have affected the meta-analysis of the drinking frequency ($P = 0.04$), but the test detects no asymmetry in the mean differences of the drinking quantity ($P = 0.25$). Egger's tests for the mean differences of the weakest MI effects did not indicate publication bias ($P > 0.37$).

DISCUSSION

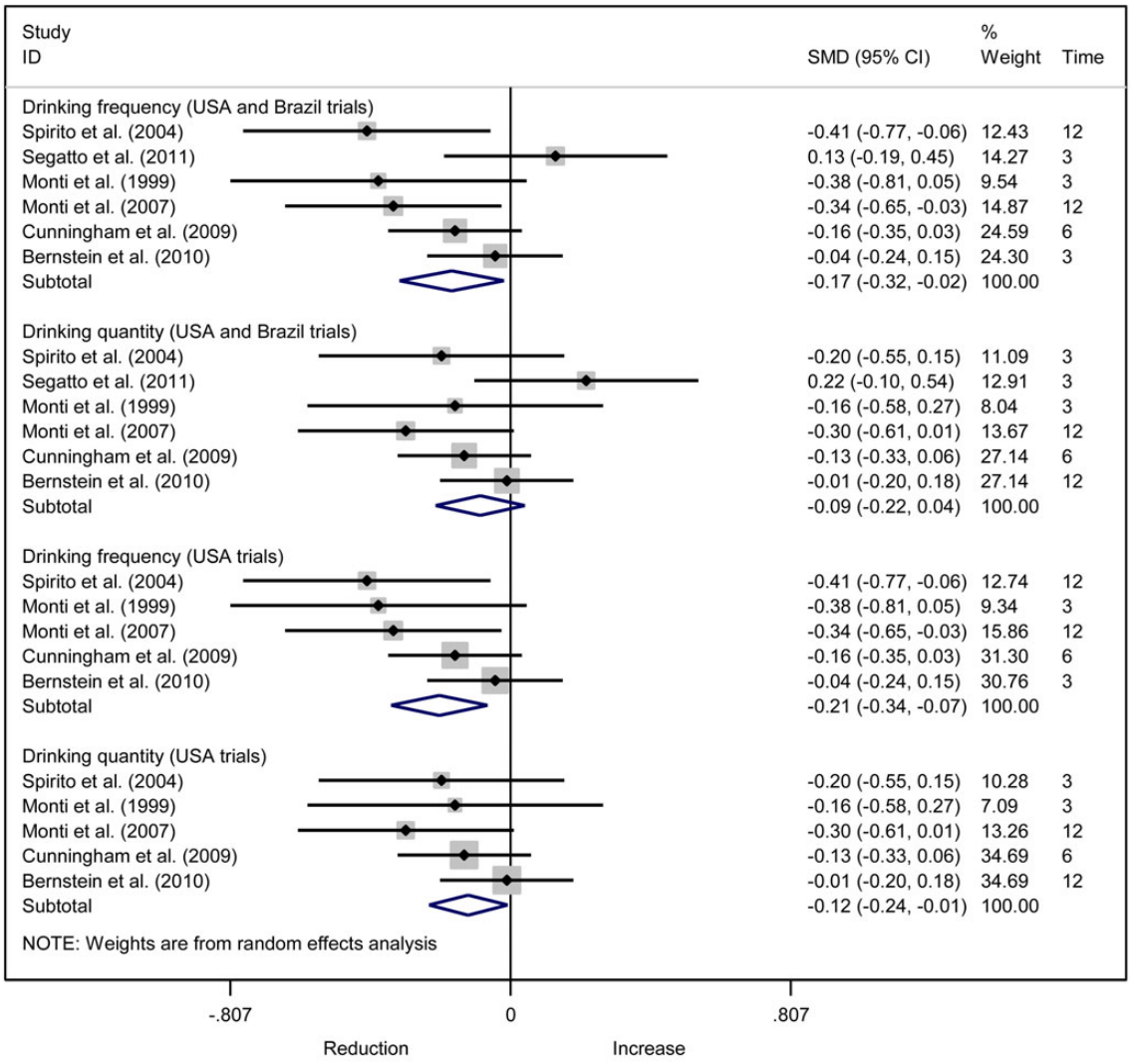
To our knowledge, this is the first systematic review and meta-analysis on the efficacy of emergency care triggered brief interventions that include MI to reduce risky drinking behaviour in young people. The included trials not only studied alcohol consumption, but also alcohol-related risks and problems. Our focus was on alcohol consumption as the outcome most comparable across trials. While four trials found MI more successful than control interventions in reducing alcohol-related consequences (Monti *et al.*, 1999, 2007; Cunningham *et al.*, 2009; Bernstein *et al.*, 2010), there was less evidence for an additional impact of MI in emergency care brief interventions when it comes to alcohol use.

One study found no change in alcohol use after either intervention (Bernstein *et al.*, 2010). Young people reduced their alcohol consumption in some way after an alcohol-related emergency care contact in five out of six RCTs, regardless of the content of the brief intervention (Monti *et al.*, 1999, 2007; Spirito *et al.*, 2004; Cunningham *et al.*, 2009; Segatto *et al.*, 2011). There is, however, debate that alcohol consumption may not be reduced as an effect of an intervention, but rather

Table 4. Methodological quality of selected studies using the CASP checklist

	CASP Checklist					
Authors	Trial addressed a clearly focused issue	Assignment of patients to treatments randomized	Follow-up[a]	Blinding	Groups similar at the start of the trial[b]	Groups treated equally
Bernstein *et al.* (2010)	Yes	Yes[c]	Yes/no	RA	Yes/no	Yes[d]
Cunningham *et al.* (2009)	Yes	Yes[c]	Yes/yes	RA	Yes/yes	Yes[e]
Monti *et al.* (1999)	Yes	Yes	Yes/no	NA	Yes/NA	Yes
Monti *et al.* (2007)	Yes	Yes[c]	Yes/no	RA	No/NA	Yes[d]
Segatto *et al.* (2011)	Yes	Yes[c]	No/no	P	Yes/no	Yes
Spirito *et al.* (2004)	Yes	Yes[c]	Yes/no	RA	Yes/yes	Yes

CASP, Critical Appraisal Skills Programme; MI, motivational interviewing; NA, not available; P, patients, RA, research assistants.
[a]Intention-to-treat analysis/dropouts included.
[b]Selected sociodemographic characteristics and alcohol consumption/alcohol-related risks.
[c]Explain method
[d]MI group also received 'booster' phone call(s).
[e]MI group also received normative resetting and skills training.



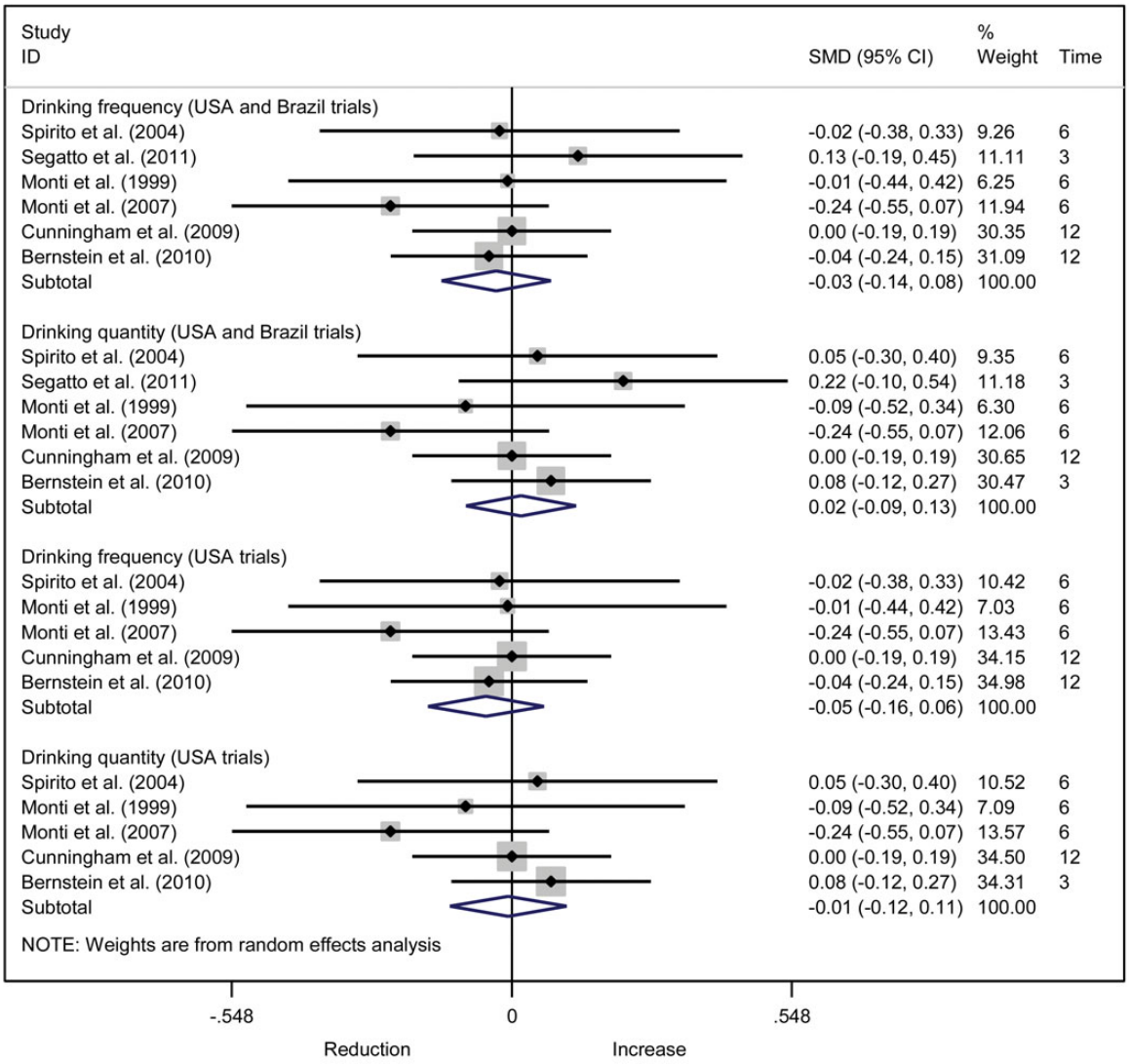
Note: Meta-analyses of largest mean differences between motivational interviewing and control interventions detected during follow-up. Subtotal summarizes the result of the meta-analysis in the subgroup of trials and drinking outcomes specified. Time indicates after how many month the data was collected. SMD standardized mean difference.

Fig. 2. Meta-analysis of the strongest effects of brief motivational interventions in emergency care on the alcohol consumption of young people.

due to regression to the mean or behavioural change resulting from screening (see, e.g. Finney, 2008; Jenkins *et al.*, 2009). The impact of such forces other than the intervention may be mitigated to some extent when differences between randomized groups are assessed. MI contributed to the reduction in alcohol consumption significantly in two studies ($P < 0.05$) (Spirito *et al.*, 2004; Monti *et al.*, 2007); of which one described a significant additional impact of MI only for the subgroup of more heavy drinkers (Spirito *et al.*, 2004).

Investigating the raw data extracted from the original studies, drinking frequency and/or quantity increased again after an initial decrease in one or both intervention groups in some trials, but usually remained below the preintervention level by the end of study period (Monti *et al.*, 1999, 2007; Spirito *et al.*, 2004; Cunningham *et al.*, 2009). In one of the trials, the control group's drinking frequency after 1 year even appears to have surpassed its baseline level (Spirito *et al.*, 2004). No relapse in alcohol use, but the increase in drinking quantity between 3 and 12 months in the Spirito *et al.* (2004) trial ($P < 0.04$), was statistically significant although the phenomenon of reraising average consumption levels occurred frequently in the trials reviewed.

The meta-analysis suggests that MI-based interventions are at least as effective as control interventions and have potential to be more effective. We conducted separate meta-analyses for the correlated drinking frequency and drinking quantity outcomes, as well as for one more, and one less heterogeneous set of trials. Based on the largest effect size differences, the frequency of drinking was reduced significantly more by MI than other brief interventions, regardless of whether we studied US trials on their own or together with a trial from Brazil (SMD ≤ -0.17, $P \leq 0.03$). Further meta-analyses indicated no significant SMD in the drinking quantity for all trials (SMD $= -0.09$, $P = 0.18$). Within the US trials only, a significantly lower amount of alcohol was consumed after a MI intervention (SMD $= -0.12$, $P = 0.04$). Meta-analyses based on the



Note: Meta-analyses of smallest mean differences between motivational interviewing and control interventions detected during follow-up. Subtotal summarizes the result of the meta-analysis in the subgroup of trials and drinking outcomes specified. Time indicates after how many month the data was collected. SMD standardized mean difference.

Fig. 3. Meta-analysis of the weakest effects of brief motivational interventions in emergency care on the alcohol consumption of young people.

smallest differences in the effect size found no differences in the alcohol consumption after intervention between groups (SMD ≤ 0.02, $P \geq 0.38$).

The Brazilian trial differed in several aspects from the US trials in the sample beyond its cultural setting: The experimental intervention was implemented solely by one researcher. The trial relied exclusively on self-report in evaluating the intervention effects, and with only one follow-up after 3 months it was the shortest trial in the sample. The sample was composed of ~40% of alcohol dependents in each group. This portion could be higher than in the other trials studied because brief interventions usually target risk populations at an early stage of alcohol-related problems (Segatto *et al.*, 2011). In addition, risks associated with alcohol abuse, which may correlate with the readiness to change alcohol consumption, were not balanced at baseline and no intention-to-treat analysis was performed. Despite these differences between trials, results from the meta-analyses with and without the Brazilian trial suggested that some additional reduction in alcohol consumption can potentially be achieved by MI.

Our review and meta-analysis are subject to limitations. The methodological quality of the studies included ranges from poor to good. The major concern with respect to the quality of the meta-analyses, which were based on unadjusted raw data, is the high numbers of dropouts of at least 6.6%, and up to 30.6% of participants. These dropout rates are likely to have introduced a substantial but unexamined bias. Publication bias was indicated for the selective study of drinking frequency outcomes from US trials with the strongest MI effects. Confirming an additional impact of MI on the drinking frequency in the meta-analysis of the USA and Brazil trials, for which a possible publication bias was not indicated, mitigates our concern that estimating a positive upper bound for an additional effect of MI in emergency care brief interventions may be a result caused by publication bias. Within the original studies, few included dropouts in their final assessment

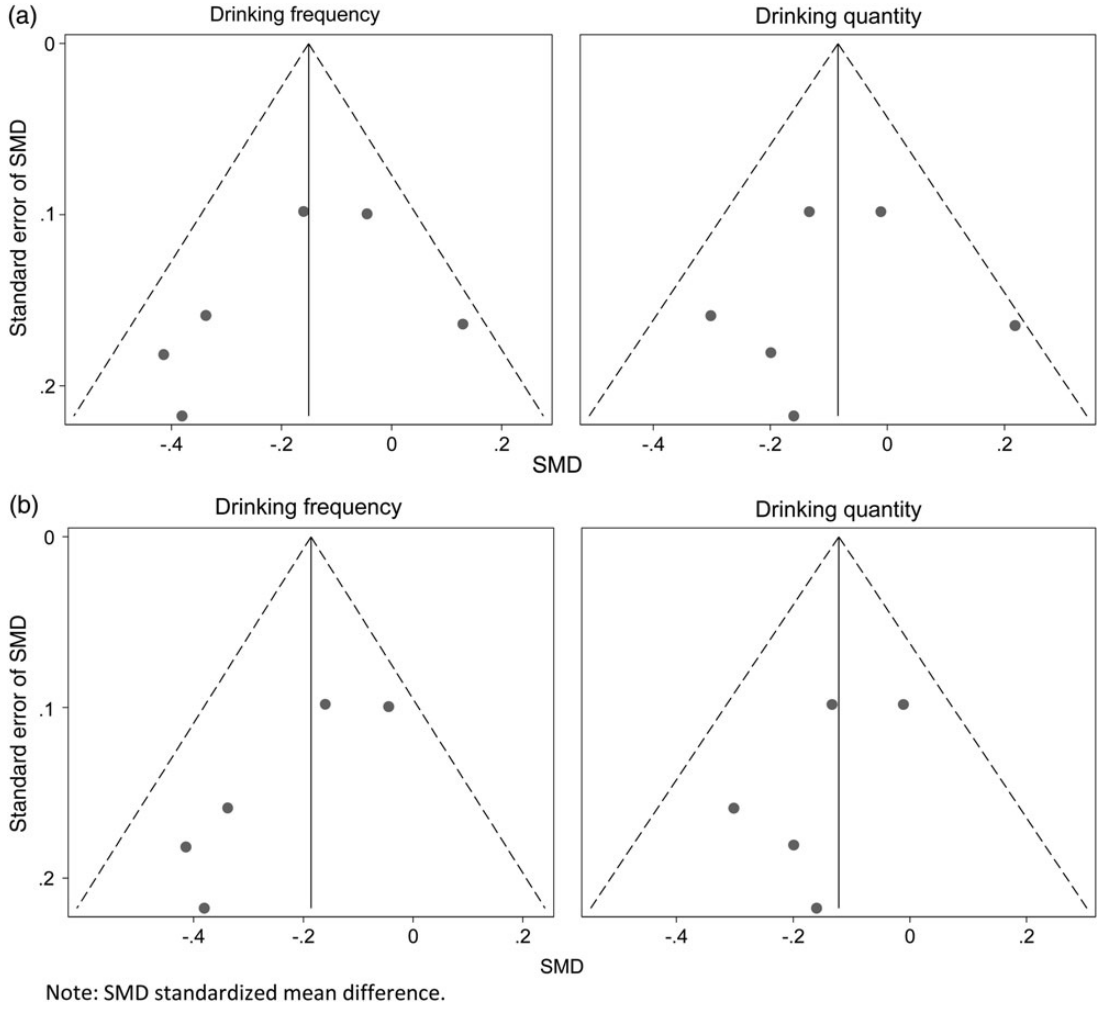


Fig. 4. (**a**) Funnel plots for USA and Brazil trials. (**b**) Funnel plots for US trials.

(Cunningham *et al.*, 2009) or made a sensitive analysis to investigate the worst-case situation of equating loss to follow-up with a negative answer for change attempts, at least for alcohol-related consequences (Bernstein *et al.*, 2010).

No reviewed study states whether MI was adapted to the special needs and demands of young people as discussed, for instance, by Gillian (1991). Combined interventions, like MI plus normative resetting and skills training or MI plus 'booster' phone calls, were tested in some studies (Monti *et al.*, 2007; Cunningham *et al.*, 2009; Bernstein *et al.*, 2010), preventing us from deducing the efficacy of MI on its own. The methodological differences in the analyses and interventions limit the comparability of the study findings reviewed. Finally, we did not study alcohol-related problems as an outcome. However, it is often a history of alcohol-related problems that brings a patient to the attention of a medical provider, and the reduction of these problems rather than alcohol consumption itself might be the aim of an opportunistic brief intervention.

CONCLUSION

Only two of six trials in our systematic review found evidence that brief motivational interventions were more efficacious than other brief interventions in emergency care when it comes to the reduction of alcohol consumption, even though motivational interventions were better able to reduce alcohol-related risks or problems in four trials. In the best case scenario, our meta-analysis suggested that MI decreased alcohol consumption more than brief interventions that use, for instance, educational brochures, contact information for community resources or personal feedback. In the conservative scenario, the meta-analysis detected no differences between brief interventions. The variability in the additional benefits of using motivational techniques in brief emergency care interventions limits their effective use. Future research should therefore assess moderators of the effect size, investigate MI in emergency care settings of further countries and evaluate alcohol-related consequences after MI interventions in emergency care in a meta-analysis. Gaining a better understanding of what makes some brief interventions more effective than others is needed to successfully reduce heavy episodic drinking among young people.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Alcohol and Alcoholism* online.

AUTHORS' CONTRIBUTIONS

A.H. had the idea for the systematic review and conducted it. S.K. had the idea for the meta-analysis and conducted it. S.K. and A.H. performed the literature search, analysed the data, interpreted the results and wrote the manuscript.

Conflict of interest statement. None declared.

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