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Brief interventions for cannabis use in emerging adults: A systematic review, meta-analysis, and evidence map

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ABSTRACT

Purpose: This systematic review summarizes and critically appraises the existing literature on brief interventions (BIs) for cannabis use among emerging adults.
Methods: Eligible BIs were operationalized as 1–2 sessions focused exclusively on cannabis use for samples with mean ages between 15 and 30. Outcomes related to cannabis use, other substance use, mental health, help-seeking, or functional status were included. Two independent reviewers screened a total of 3638 records, identifying 244 studies for full-text screening. In total, 32 BIs in 26 primary studies with 6318 participants were included.
Results: Participants were typically not seeking treatment and using cannabis at least once a month. Most interventions were motivational, single sessions, and delivered in person. Few discussed concurrent psychiatric conditions. Pooling results at 1–3 months post-intervention, BIs compared to passive control slightly reduced symptoms of cannabis use disorder (SMD −0.14 [95% CI −0.26 to −0.01]) and increased the odds of abstinence (OR 1.73 [95% CI 1.13–2.66]). Other outcome results often favored BIs but were not significant. Results of studies comparing types of BIs (k = 8) or BIs to longer interventions (k = 1) are discussed narratively. Quality assessment suggested low to very low-quality evidence.
Conclusions: This review indicates that BIs targeting non-treatment seeking emerging adults result in significant reductions in symptoms of cannabis use disorder and an increased likelihood of cannabis abstinence, however evidence is of low quality.

1. Introduction

Cannabis is one of the most commonly used substances and the prevalence of past-year cannabis use is highest among emerging adults (*i.e.*, 17–25 years of age) (National Institute on Drug Abuse (NIDA, 2016; Statistics Canada, 2017). Recent data indicate increases in the prevalence of cannabis use among emerging adults in North America, with about 30–50% of emerging adults who use cannabis reporting problems related to their use (Hasin et al., 2015; Ialomiteanu et al., 2018). Emerging adulthood is the distinct developmental period between adolescence and adulthood in developed countries, during which young adults are often attending post-secondary schooling or job training and are establishing their independence, but do not yet carry the full weight of responsibilities and expectations of adulthood (Arnett, 2000). Emerging adults, like adolescents, are more vulnerable to the effects of cannabis than adults given ongoing brain development up to the age of 25 (Berman et al., 2009). Regular use during this time is associated with increased likelihood of addiction, impaired neuronal-maturation, cognitive impairment, poor educational and occupational outcomes, lower life satisfaction, lung health concerns, and increased risk of mental health problems (Gobbi et al., 2019; Fischer et al., 2017; Thompson et al., 2018; Volkow et al., 2014). Risk of harm from cannabis use is greater for individuals who begin using cannabis during adolescence and emerging adulthood (Volkow et al., 2014; Winters and Lee, 2008).

Rates of professional help-seeking for substance use concerns among adolescents and emerging adults are low (about 15%) (Gulliver et al.,

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2010; Merikangas et al., 2011). Barriers to accessing help commonly include: fear of judgment, lack of knowledge of treatment options, long wait times for help, and lack of perceived need for help or time to seek help (Ballon et al., 2004; Berridge et al., 2018; Eisenberg et al., 2007; Gates et al., 2012; Gulliver et al., 2010). Additionally, shifts in the social and political climate in North America regarding cannabis have contributed to an increase in the perceived social acceptability of cannabis use among emerging adults (Berg et al., 2015) and a reduction in the perceived risks (Okaneku et al., 2015). Thus, engagement of emerging adults in interventions for problematic cannabis use are critical.

Importantly, cannabis use occurs along a continuum in terms of the quantity and impact of use. The continuum can include: no use, beneficial use, non-problematic use, problematic use, potentially harmful use, and use at the level of a cannabis use disorder (Ministry of Health and Long-Term Care, 2018). This suggests the need for a stepped-care model of interventions for cannabis use concerns ranging from universal prevention, to early brief intervention or secondary prevention, to targeted and increasingly specialized and intensive interventions (Canadian Centre on Substance Abuse and Addiction, 2015; NICE, 2011; Rush, 2010). Emerging adults can experience problems related to cannabis use without meeting criteria for a substance use disorder (Caldeira et al., 2008). Early brief interventions are particularly important for emerging adults using cannabis given neuro-developmental vulnerability and potential for long-term consequences (Berman et al., 2009; Volkow et al., 2014).

Brief interventions (BIs) are interventions which are typically short in duration and adopt a motivational interviewing (MI) or enhancement (MET) approach to provide psychoeducation, motivate clients to change, teach behavioral change skills, and connect those in need to additional services (Winters et al., 2007; Tevyaw and Monti, 2004; Carney et al., 2016; World Health Organization (WHO, 2010; Matua Raki, 2012). BIs may be appropriately used at various points along the intervention continuum including: secondary prevention for individuals using cannabis who are either not currently experiencing problems or are at high risk to develop substance use or mental health disorders, and early intervention for those requiring more intensive treatment with the goal to facilitate connection to ongoing services (Canadian Centre on Substance Abuse and Addiction, 2015; Carney et al., 2016; Matua Raki, 2012; Rush, 2010; Tevyaw and Monti, 2004; Winters et al., 2007; World Health Organization (WHO, 2010). BIs have the potential to efficiently address and mitigate many of the challenges related to reducing cannabis use and harms and barriers to accessing help.

Systematic reviews for MI and BIs for emerging adults have demonstrated mixed results. Previous reviews found MI to reduce general substance use in the short and longer term among older adolescents and emerging adults (Barnett et al., 2012; Dennhardt and Murphy, 2013; Jensen et al., 2011). In-person BIs delivered in schools for adolescents under 19 have been found to reduce frequency of cannabis use in comparison to assessment only (low quality evidence; SMD −0.54 [−0.77, −0.31]; k = 2, n = 338), but frequency and dependence were not significantly different compared to psychoeducation alone (Carney et al., 2016). A recent narrative review of cannabis BIs for post-secondary students found weak and inconsistent benefits of BIs in the short-term (Li et al., 2019). These reviews are limited as they do not consider emerging adults specifically, combine cannabis use with all substances and do not specifically target cannabis use, do not combine results meta-analytically, combine all intervention durations not restricting to BIs, and/or restrict interventions based on delivery method and location.

There are two additional reviews targeting adults or mixed age samples of relevance to the current study. Gates et al. (2016) identified 23 RCTs of psychosocial interventions for adults with symptoms of cannabis use disorder (CUD) or near daily users of cannabis who were seeking treatment for their cannabis use. This review found that adults receiving a psychosocial intervention versus an inactive control reported fewer days of cannabis use (moderate quality evidence), a higher likelihood of point-prevalence abstinence, fewer symptoms of dependence, fewer cannabis-related problems (low-quality evidence), and fewer joints used per day (very low-quality evidence). Interventions longer than four sessions and lasting more than a month demonstrated better outcomes, and cognitive behavioral therapy followed by motivational approaches produced the largest effects (Gates et al., 2016). Imtiaz et al. (2019) identified nine RCTs comparing cannabis BIs delivered in healthcare settings to inactive control and found there were no significant differences between groups for frequency of cannabis use or symptoms of CUD in the short or long-term. However, given that emerging adults are developmentally distinct from adults (Arnett, 2000), may not have progressed to daily use or dependence, and have differences related to neurocognition and motivation (Silvers, et al., 2019), there is a need to consider them separately.

Thus, the current study is a systematic review, meta-analysis, and evidence map of the existing literature on the nature and efficacy of brief interventions (1–2 sessions) for cannabis use among emerging adults. As emerging adulthood overlaps late adolescence and early adulthood, any study that predominantly included participants with mean ages between 15 and less than 30 was considered. We present the scope of the existing evidence for several developmental age groups: (1) late adolescence (*i.e.*, maximum age 19, typically high-school students), (2) emerging adulthood (*i.e.*, around 17–24 years of age, typically post-secondary students), and (3) young adulthood (*i.e.*, mean ages between 25 and 30). Additionally, this review provides a comprehensive description of the content and delivery methods of existing BIs and conducts meta-analyses when possible. The results of this review provide an overview of existing BIs for cannabis and their effectiveness, to guide further evaluation during this crucial time of development.

2. Methods

The protocol was registered on PROSPERO (CRD42018085412) and underwent peer-review (Halladay et al., 2018). Please see the published protocol for details on review methods (Halladay et al., 2018) (See Supplementary Materials [SM][1] for minor amendments).

2.1. Eligibility criteria

We included all RCT designs and observational intervention studies. The target population was emerging adults. To be comprehensive, given emerging adults share characteristics with the preceding and subsequent developmental stages of adolescence and young adulthood, samples that overlapped emerging adulthood (*i.e.*, 17–25) with a mean age between 15 and less than 30 years of age were included. BIs were operationalized as one to two sessions focused exclusively on cannabis use. No restrictions were placed on types of comparison groups, which included: passive control (*i.e.*, usual care or no intervention), active comparators (*i.e.*, other types of BIs or longer interventions), and pre-post studies with no comparison groups. Studies were included that measured cannabis-related outcomes (primary outcomes) as well as secondary outcomes including other substance use related outcomes, help-seeking behaviors, mental health related outcomes, and any academic or occupational related outcomes, given the known associations between cannabis use and these problems among emerging adults. All available follow-up time points were collected.

2.2. Search strategy

The search was conducted in OVID MEDLINE In-Process (1946 to week 7 2019), EMBASE (1974–2019 February 11), the Cochrane Central Register of Controlled Trials, Allied and Complementary Medicine (1985 to February 2019), CINAHL, and PsychInfo (1806 to February week 2 2019). Ongoing trials were identified using the World

[1] Supplementary material can be found by accessing the online version of this paper at https://doi.org/10.1016/j.drugalcdep.2019.107565.

Health Organization International Clinical Trials Registry Platform, Clinical Trials.gov, and Current Controlled Trials. Unpublished trials were identified using Proquest Dissertations, OpenGrey, Google Scholar, and the Substance Abuse and Mental Health Services Administration website. No restrictions were placed on language or publication status. We checked abstracts and reference lists of included articles and systematic reviews. The search strategy included terminology related to BIs and cannabis, without terms related to age or article type (See SM[1] for specific terms mapped in each database). The screening form was pre-piloted and included criteria pertaining to the target population, design, intervention, and outcomes (See SM[2] for form). Two reviewers independently screened a total of 3638 records after duplicate removal, identifying 244 studies for full text. Reviewers agreed on 91% of records, yielding 'very good' inter-rater reliability for full-text screening according to a κ of 0.809 (95% CI 0.745, 0.864) (Altman, 1990). Discrepancies were resolved by discussion or a third reviewer. In total, 32 BIs (i) in 26 studies (k) with 19 supplementary papers were included in this review. See Fig. 1 for the Flow Diagram.

2.3. Quality assessments

Risk of bias (RoB) of included RCTs was assessed using the Cochrane RoB tool at the outcome level (Higgins and Green, 2011) and observational studies were assessed with the CLARITY tools for Cohort Studies (CLARITY Group at McMaster University, 2018). The Grading or Recommendations Assessment, Development and Evaluation (GRADE) approach was used to assess the total quality of the evidence for each outcome (Schünemann et al., 2013). This protocol follows procedures outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P) statement (SM)[1].

2.4. Data extraction and analysis

Two reviewers extracted information on population and intervention characteristics and treatment outcomes with disputes resolved by a third reviewer. Subsequently, all primary authors were contacted (three attempts) to verify intervention contents and missing data. Most missing data was due to loss to follow up and the use of complete cases; for dichotomous data, when events were missing, we performed sensitivity analyses considering worst-case scenario (*i.e.*, assuming all participants experienced the "bad" outcome) and best-case scenario; for continuous outcomes, meta-analyses included imputed results where possible and subgroup analyses based on attrition bias (*i.e.*, >20% attrition).

We pooled scores at 1–3 months, 6 months, and 12 months post intervention. Other time points were reported narratively. The measurement tools used were inconsistent and therefore standardized mean differences (SMDs) were used to combine continuous outcomes of similar constructs. SMDs were calculated using the inverse variance method in a random effects model within Review Manager 5 (RevMan) software, which uses the Hedges adjusted g formula (Higgins and Green, 2011). SMDs (Hedges g) of 0.2 were interpreted as small but meaningful effects (Cohen, 1988; Higgins and Green, 2011). For frequency of use, we also calculated mean differences (MD) for all studies with results that could accurately be converted to number of days of cannabis use over the past month. For abstinence, Odds Ratios (OR) were combined using the inverse variance method in a random effects model and reported as a pooled OR (Higgins and Green, 2011).

Unit of analysis issues were accounted for in meta-analyses. For factorial designs, the sample size of the duplicate group was divided in half, keeping means and standard deviations unchanged (Higgins and Green, 2011). Similarly, analyses of CUD symptoms, scores for cannabis dependence, cannabis abuse, and cannabis severity were combined by dividing sample sizes accordingly so all measures could be pooled in one meta-analysis. In the DSM-IV, abuse and dependence were separate diagnoses while in the DSM-5, CUD specifies severity by indicating different degrees of problematic use based on symptoms of both abuse and dependence (American Psychiatric Association (APA, 1994, 2013). There was only one cluster-randomized study (Laporte et al., 2017), which was adjusted for clustering by using the reported intra-class correlation coefficient (ICC), the associated design effect (DE) and effective sample size calculated (Higgins and Green, 2011) (SM[1]).

Due to a lack of statistical heterogeneity found in this review and few significant univariate subgroup results, no meta-regressions and not all pre-planned subgroup effects were evaluated. Subgroup differences were performed for: length of BIs, method of delivery (online *vs.* in-person), measurement instrument used, type of BI, and attrition. Pooled SMDs and ORs for primary outcomes, along with the GRADE assessment, are presented in a Summary of Findings table. When pooling results was not possible due to insufficient studies, results are presented narratively.

Evidence maps are presented utilizing methods described by Katz et al. (2003) and Miake-Lye et al. (2016). The evidence is presented in tables stratified by developmental age. Four evidence maps are presented including: (1) proportion and type of studies; (2) population characteristics; (3) summary of intervention characteristics; and (4) content characteristics of brief motivational interventions.

3. Results

3.1. Characteristics of included studies

There were 26 primary studies including 6318 participants. The mean age of participants ranged from 15 to 29. Studies were conducted predominantly in the United States (16/26) followed by Australia (3/26). One study was a pre-post design and the remaining were RCTs. However, two RCTs were analyzed as pre-post studies since both intervention arms received the same BI and were randomized to non-psychotherapeutic co-interventions (Tables 1 and 2 for a summary and further details in SM[1]).

Half of the studies recruited from schools. Other sampling locations included the general community (k = 5), primary care (k = 2), Emergency Department (k = 1), Truancy Centre (k = 1), and a combination of settings (k = 4). The majority of the included studies targeted non-treatment seeking individuals who were using cannabis at least once a month (Table 3). Only two studies included individuals explicitly seeking help for cannabis use (Copeland et al., 2017; Fernandes et al., 2010) and one targeted a mixture of emerging adults, some not actively seeking help and others actively seeking help for substance use (Jonas et al., 2012). Cannabis inclusion criteria included: any past year use (k = 1), any use in the past 3 months (k = 1), at least monthly use (k = 7), at least weekly use (k = 3), and more than weekly use (k = 8), signs of cannabis dependence (k = 5), and non-mandated students who committed a cannabis infraction of campus drug policy (Hwang and Earleywine, 2017). Two studies excluded participants with a risk of severe cannabis dependence (Palfai et al., 2014; Poblete et al., 2017). The majority (65%, k = 17) had no inclusion or exclusion criteria pertaining to frequency or dependence on other substances with nine remaining studies excluding individuals based on heavy use or dependence of other substances. Almost half of the studies (42%) had some form of mental health exclusion criteria but often lacked specifics in terms of the nature and severity of disorders excluded.

The most commonly reported outcome was frequency of cannabis use (k = 23), followed by cannabis use consequences (k = 13), then symptoms of CUD (k = 11). Only three studies measured abstinence. Other substance use including alcohol-related outcomes (k = 7), tobacco-related outcomes (k = 3), and illicit substance use (k = 3) were measured. Only three studies assessed help-seeking behaviors, one assessed functioning, and one measured mental health outcomes. The most common follow-up time was three months post-intervention.

3.2. Characteristics of interventions

Most interventions were brief motivational interventions (BMIs; i = 27), two were psychoeducational, one was a normative-feedback only intervention (Hernandez-Meier and Otto-Salaj, 2016), one involved setting a

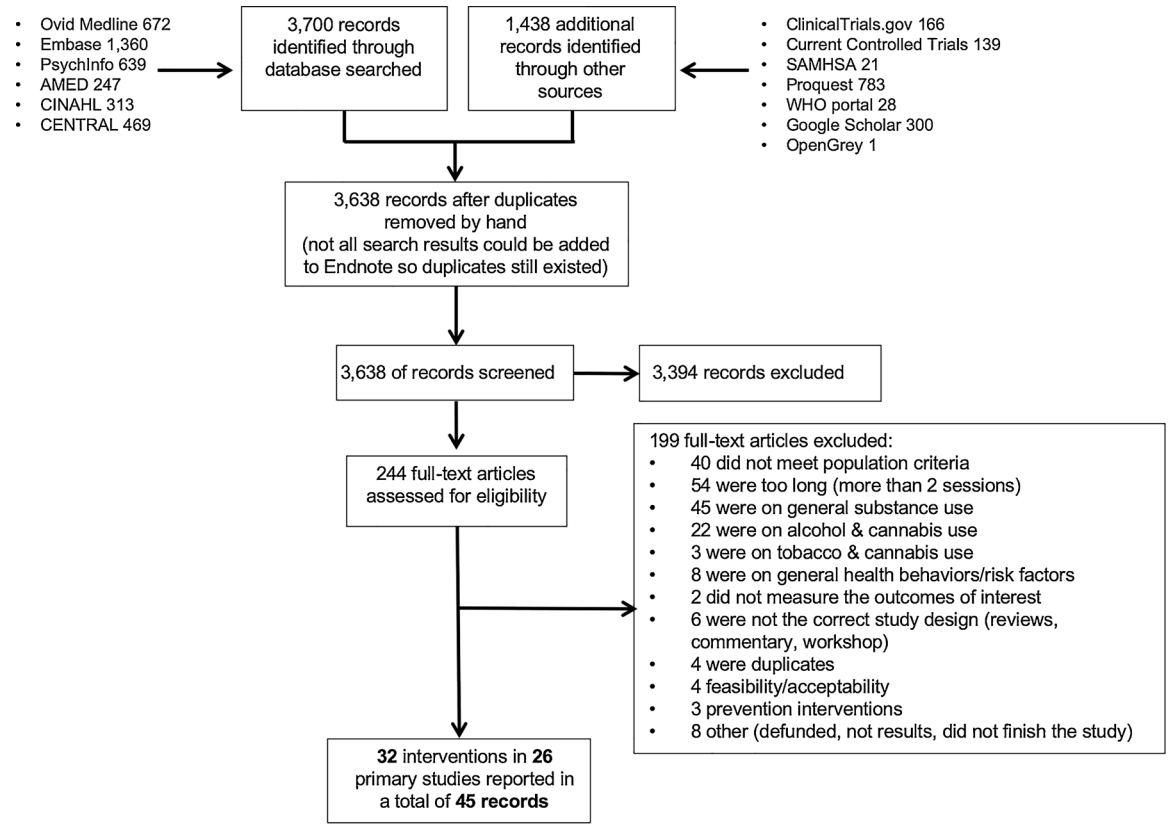

Fig. 1. A flow diagram following the PRISMA template of included studies.
This flow diagram depicts the sequence of identifying studies for inclusion in this review.

stop-date (Fernandes et al., 2010), and the last was an integrated brief intervention (IBI) (Lang et al., 2000) (Table 2). The majority were single session interventions (69%; i = 22) and were delivered in-person (59%; i = 19). Only one intervention was delivered by a peer educator (Bernstein et al., 2009), while other BI-counsellors were clinicians or trained students in health or mental health programs. Nine BIs were delivered online through automated online feedback, one was text-based chat with a clinician (Jonas et al., 2012), one used a written booklet (Fischer et al., 2013), and two were delivered by phone (Fernandes et al., 2010). BIs ranged from 5 to 150 min in duration. Several BIs offered optional additional treatment components including: structured self-help CBT/skills booklets following the BI sessions (Lang et al., 2000; Walker et al., 2006), an optional BI component with strategies for quitting or reducing use (Martin and Copeland (2008), and optional CBT sessions for all participants (Walker et al., 2011, 2016; See Table 4 for a summary of intervention characteristics).

See Table 5 for a summary of the included intervention components for the 28 BMIs (including the IBI). The most common components in 70% or more of the BMIs included providing personalized feedback regarding frequency of cannabis use and discussing the pros and cons of use. Less common components were discussions of motives for use (21%), role-plays (11%), or discussion of mental health concerns (14%). When mental health concerns were addressed, personalized feedback regarding the nature or severity of concerns was not typically provided. The psychoeducational interventions did not provide feedback or address content indicated in Table 5. Psychoeducational interventions were differentiated from usual care, which included pamphlets or written educational materials, by involving some form of *enhancement* (enhancement included educational materials that were personalized, had extra visuals such as a PowerPoint, video, or interactive materials, or were supplemented with a consistent discussion about the materials). The two psychoeducational interventions were enhanced by: a computerized animation with a quiz (Gee et al., 2014) and a didactic comprehensive PowerPoint presentation (Walker et al., 2011). The two remaining studies (not included in Table 5) provided only normative-feedback (Hernandez-Meier and Otto-Salaj, 2016) and setting a stop-date (Fernandes et al., 2010) (Table 5).

3.3. Risk of Bias (RoB) assessment

Most of the included RCTs were moderate to high RoB, mainly due to insufficient reporting on allocation concealment, inability to blind participants, self-reported non-standardized outcome assessments, attrition, and lack of intervention fidelity monitoring. High RoB is inevitable among studies in which an in-person BI is compared to passive control, due to the inability to blind participants and counsellors to group assignment. Only four studies explicitly mentioned that participants were blinded to treatment condition. Since all of the outcomes were measured through self-report questionnaires, most studies that did not blind participants present a high risk of detection bias[2]. Additionally, about 38% (k = 10) of the included studies had significant attrition (>20%), with limited accounting for attrition. For "other", seven RCTs were judged as high RoB due to lack of fidelity monitoring or poor compliance with intervention procedures. Fig. 2 presents RoB assessments for each individual RCT for frequency of cannabis use outcomes and Fig. 3 summarizes the authors' judgments about each RoB item presented as percentages across all studies.

Only three included studies were pre-post designs, two of which were RCTs in which both groups received the same BMI (randomized oxytocin or fMRI) while the other was a typical pre-post design. While follow-up rates were high, none of these studies monitored for fidelity, adjusted or controlled for time-varying factors and assessment instruments were of

[2] Since Time-Line Follow-Back (TLFB) is the gold standard for assessing frequency of substance use, two studies that used TLFB were judged as low risk of detection bias even if participants were not blind (Lee 2010, Martin, 2008; Stein, 2011; Bernstein, 2009).

Table 1
Summary of included studies.

Author	Country	Mean Age & Age Group	Sampling Location(s)	Allocated Total Sample Size	Intervention(s)	# sessions Length In-person/online	Comparison(s)	Outcome(s) of interest
Bernstein	USA	14-21 Emerging Adults	Paediatric emergency department	139	BMI	1 session 20-30mins In-person 1 booster call 5-10mins	Passive	Cannabis Abstinence* Cannabis Frequency* Help-seeking
Copeland	Australia	18-64 Young Adults	General Community	287	"Grassessment" (BMI) 1. Brief Feedback 2. Extended Feedback	1 session (both) Length not reported Online (both)	Between BI intervention conditions	Cannabis Frequency Quantity of Cannabis Use Cannabis Dependence
Elliott	USA	19.34 Emerging Adults	University	162	"e-TOKE" (BMI)	1 session 20-45mins Online	Passive	Cannabis Frequency* Cannabis Consequences* Cannabis Abuse* Cannabis Dependence*
Feldstein Ewing	USA	16.09 Adolescent	Juvenile justice system	43	BMI	2 sessions 60mins each In-person	BMI (randomized fMRI condition)	Cannabis Frequency Cannabis Consequences Cannabis Dependence Alcohol Use Tobacco Use
Fernandes	Brazil	25 Young Adults	Toll-Free Phone Call	1,744	1. BMI 2. Goal-setting only	1 session 20mins Telephone	Active (Goal-Setting Only)	Cannabis Abstinence Cannabis Reduction Cannabis Relapse
Fischer	Canada	20.6 Emerging Adults	University	134	1. BMI (orally-delivered) 2. BMI (written)	1 session (both) 20-30mins (both) 1. In-person 2. Booklet	1. General Health Education (in-person) 2. General Health Education (booklet)	Cannabis Frequency
Gee	The Netherlands	18.1 Emerging Adults	Educational settings; Youth care; Coffee shops; Peer education projects	119	1. "Weed Check" BMI 2. Educational BI	1. 2 sessions 60-90mins In-person 2. 1 session 56mins In-person	Active (Cannabis Education)	Cannabis Use Quantity Cannabis Frequency Cannabis Dependence Mental Health Outcomes
Hernandez-Meier	USA	18.38 Emerging Adults	University	117	Normative Feedback	1 session 5mins Online	Active 1. Alcohol and Marijuana Feedback 2. Alcohol Only Feedback	Cannabis Frequency Alcohol Use Heavy Drinking
Hwang	USA	19.03 Emerging Adults	University	167	BMI	1 session 90mins In-person	Passive	Cannabis Frequency* Cannabis Consequences*
Jonas	Germany	24.2 Emerging Adults	Drugcom.de Users University Ads Search Engine Ads Social Network	67	BMI	1 session 30mins Online	Passive	Cannabis Frequency*
Lang	Australia	29 Young Adults	Health Care Services DIRECTLine Counselling Service	30	IBI (Integrated Brief Intervention)	1 session 2.5hrs In-person	Pre-Post	Cannabis Frequency Cannabis Consequences Functioning
Laporte	France	20.6 Emerging Adults	Primary Care	262	"CANABIC" BMI	1 session Length not reported In-person	Passive	Cannabis Frequency* Tobacco Use Alcohol Use

(*continued on next page*)

Table 1 (*continued*)

Author	Country	Mean Age & Age Group	Sampling Location(s)	Allocated Total Sample Size	Intervention(s)	# sessions Length In-person/online	Comparison(s)	Outcome(s) of interest
Lee 2010	USA	18.03 Emerging Adults	College	341	"Adapted Teen Marijuana Check-up" BMI	1 session Length N/A (self-led) Online	Passive	Cannabis Frequency* Cannabis Consequences*
Lee 2013	USA	20 Emerging Adults	College	212	BMI	1 session 60mins In-person	Passive	Cannabis Frequency* Cannabis Consequences*
Martin	Australia	16.5 Adolescent	Community	40	"Adolescent Cannabis Check-Up" BMI	2 sessions Length not reported In-person	Passive	Cannabis Frequency* Cannabis Dependence*
McCambridge	England	18.0 Emerging Adults	Further Education Colleges	326	BMI	1 session 60mins In-person	Passive	Cannabis Frequency* Cannabis Dependence* Cannabis Consequences* Cigarette Frequency Cigarette Dependence Alcohol Frequency Alcohol Dependence
Palfai	USA	Controls: 20.33 and 19.62 Interventions: 19.33 and 19.35 Emerging Adults	Undergraduate University Students	123	"eCHECKUP" BMI	1 session 10-15mins Online	Passive	Cannabis Frequency* Cannabis Consequences*
Poblete	Chile	Intervention: 28.6 Control: 29.7 Young Adults	Primary Care Emergency Rooms Police Stations	287	"ASSIST-linked BI" BMI	1 session 18mins In-person	Passive	Cannabis Dependence*
Riggs	USA	Mean age Not reported Emerging Adults	Undergraduate University	301	"eCHECKUP" BMI	1 session 10-15mins Online	Active (Health Stress Management Strategies)	Cannabis Frequency Cannabis Consequences Number of Protective Behavioural Strategies Used
Sherman	USA	25.5 Young Adults	Community	16	BMI	3 sessions 45-60mins each In-person	Pre-Post	Cannabis Frequency
Stein	USA	20.5 Emerging Adults	Community	332	BMI	2 sessions 45mins each In-person	Passive	Cannabis Frequency (estimated indirectly) Cannabis Consequences*
Towe	USA	19.77 Emerging Adults	University	82	BMI	1 session Length not reported Online	Passive	Cannabis Frequency* Cannabis Dependence* Cannabis Abuse* CUPIT Score* Cannabis Consequences* Alcohol Use Other Drug Use
Walker 2006	USA	15.75 Adolescent	High school	97	"Teen Marijuana Check-up" BMI	2 sessions 30-60mins each In-person	Passive	Cannabis Frequency* Cannabis Dependence* Cannabis Abuse*
Walker 2011	USA	16.0 Adolescent	High school	310	1. BMI "Teen Marijuana Check-up" 2. Psycho-Ed	2 sessions (both) 45-50mins each (both) In-person (both)	Active (Psycho-Education)	Cannabis Frequency* Cannabis Dependence* Cannabis Abuse* Cannabis Consequences* Cannabis Abstinence Alcohol Use Other Drug Use Help-seeking

(*continued on next page*)

Table 1 (*continued*)

Author	Country	Mean Age & Age Group	Sampling Location(s)	Allocated Total Sample Size	Intervention(s)	# sessions Length In-person/online	Comparison(s)	Outcome(s) of interest
Walker 2016	USA	15.84 Adolescent	High school	252	BMI	2 sessions 50mins each In-person	Active (BMI + motivational check-ins)	Cannabis Frequency Cannabis Consequences Cannabis Use Disorder Problems Help-seeking
Walton	USA	16.3 Adolescent	Community primary health care clinics	328	1. BMI (therapist) 2. BMI (computer)	1 session (both) Length not reported 1. In-person 2. On tablet	Passive	Cannabis Frequency* Cannabis Consequences* Alcohol Use Other Drug Use

* Indicates inclusion in main primary outcome meta-analyses.

Table 2
Evidence Map #1, Study Types.

	# Total	Type of Intervention Comparisons*				Interventions Types*				Study Follow-up Times		
	Participants & Interventions & Studies	Pre-Post	BI *vs.* Passive Control RCTs	BI *vs.* BI RCTs	BI *vs.* Longer Intervention RCTs	MBI (i)	CBT (i)	Psycho -Ed (i)	Other (i)	Short ≤ 3m	Inter-mediate > 3 < 7m	Long ≥ 7m
Adolescents	1,070 participations in 8 BIs in 6 primary studies	1	6 comparisons in 4 studies	2 comparisons in 2 studies	1	7	0	1	0	5	2	3
Emerging Adults	2,884 participations in 17 BIs in 15 primary studies	0	11 comparisons in 11 studies	6 comparisons in 4 studies	0	15	0	1	1	15	6	3
Young Adults	2364 participations in 7 BIs in 5 primary studies	2	1 comparison in 1 study	2 comparisons in 2 studies	0	5	0	0	2	4	0	0
Total	**6318 participations in 32 BIs in 26 primary studies**	3	18 comparisons in 16	10 comparisons in 8 studies	**1**	**27**	**0**	**2**	**3**	**24**	**8**	**6**

Table 3
Evidence Map #2, Population Characteristics.

	Treatment Seeking				Cannabis Related Inclusion Criteria				Other Exclusion Criteria re: substance use other than cannabis and mental health concerns.							
	Any Health, Mental Health, or Substance use Treatment seeking		Treatment seeking for ***cannabis*** use		>weekly cannabis use		Some indication of dependence, abuse, disorder, or problems		***Any*** regular or problematic substance use		***Any*** Mental Illness or treatment		Mental Illness or treatment ***other than*** conditions that would inhibit ability to participate (*i.e.* cognitive status, thought disorder)	
	k	%	k	%	k	%	k	%	k	%	k	%	k	%
Adolescents (k = 6)	1	17%	0	0%	4	67%	0	0%	1	17%	5	83%	1	17%
Emerging Adults (k = 15)	3	20%	1	7%	4	27%	4[1]	27%	4	27%	3	20%	2	13%
YoungAdults (k = 5)	2	40%	2	40%	0	0%	4[2]	80%	4	80%	3	60%	3	60%
Total (k = 26)	**6**	**23%**	**3**	**12%**	**8**	**31%**	**8**	**31%**	**9**	**35%**	**11**	**42%**	**6**	**23%**

[1]one study included students who committed a cannabis infarction and one study excluded individuals with cannabis dependence.
[2]one study excluded individuals with cannabis dependence.

mixed quality. No observational study was rated as low RoB.

3.4. Effects of BIs

Results are presented for primary outcomes (*i.e.*, cannabis related outcomes) followed by secondary outcomes, in order of frequency of reporting among included studies. More details regarding the analyses, including subgroup and sensitivity analyses, are included in the SM[1].

3.4.1. Brief interventions compared to passive control

3.4.1.1. Frequency of cannabis use. Pooling data from 16 interventions in 14 studies (n = 2236), we found no significant difference in frequency of cannabis use at 1 to 3 months post-intervention between BI and passive control (SMD −0.06 [95% CI −0.14 to 0.03]) (See Fig. 4). Of the studies that could be accurately converted to number of days of use in the past month, the pooled MD was −0.55 (95% CI −1.26 to 0.16; n = 1804). Therefore, on average, BIs reduced frequency of use by about half a day in the past month. Pooling data at six months from seven MBIs in six studies (n = 1260), there was no significant difference between BI and passive control (SMD 0.01 [95% CI of −0.10 to 0.12]). Similarly, no difference was found at 12 months pooling four interventions in three studies (SMD 0.05 [95% CI-0.13 to 0.23]; n = 508). Consistent with the lack of statistical heterogeneity (I^2 0%), there were no significant subgroup differences across meta-analyses. Two studies could not be included in the meta-analysis; one found no significant difference between groups (Poblete et al., 2017) and the other found the MBI group had larger reductions in use than the control (Stein et al., 2011). In general, emerging adults who received a BI reported lower cannabis use at follow up by about half a day in the past month, which was not significantly different compared to those who received a passive control.

3.4.1.2. Cannabis use consequences. Pooling data from 11 interventions in nine studies (n = 1822), cannabis use consequences were lower for BIs compared to passive control at short term follow-up (SMD −0.16 ([95% CI −0.32 to 0.01]) although there was substantial heterogeneity (I^2 65%) and the effect was not statistically significant (See Fig. 5). Statistical heterogeneity was explained by a single study (Walker et al., 2011); after removal of this study heterogeneity was 2% (SMD −0.03 [95% CI −0.13 to 0.07]; n = 1517). No other consistent and meaningful subgroup effects emerged. At six months, pooling six interventions in five studies (n = 1109) there was no significant difference between BIs and passive control (SMD −0.04 [95% CI −0.16 to 0.09]; I^2 8%). Stein et al. (2011) could not be included in the meta-analysis but reported a non-significant difference between groups at three or six months. Only Walton et al. (2013) reported effects at 12 months follow-up and found no significant differences. Overall, cannabis use consequences were often lower among individuals who received a BI compared to passive control, but this effect did not reach statistical significance.

3.4.1.3. Risk of cannabis use disorder. Pooling data from eight interventions in seven studies (n = 1173) there was a small significant reduction in risk of CUD favoring BIs (SMD −0.14 [95% CI −0.26 to −0.01]; $p = 0.04$)[3]. The overall I^2 was 10% (See Fig. 6). There were several significant subgroup differences showing larger effects for: (1) adolescents ($p = 0.009$); (2) studies with <20% attrition ($p = 0.06$); and (3) interventions >20 min ($p = 0.08$). Extreme caution should be used when interpreting these subgroup differences due to small subgroup sizes. At six months, McCambridge et al. (2008) (n = 244) found no significant difference in dependence scores

[3] One study included measures of abuse, dependence, and an overall risk score assessed with CUPIT; only CUPIT score was included in this meta-analysis as the sample size was small even at 1-month follow-up (n = 35).

Table 4
Evidence Map #3, Summary of Intervention Characteristics.

	# single session interventions	# online or paper based interventions	#fidelity monitoring; # not applicable	Length of Interventions (total across all sessions)			
				<20mins	20 to 60mins	>60mins	Unknown (# online; # in person)
Adolescents (i = 8)	2	1	7; 1	0	0	5	3 (1;2)
Emerging Adults (i = 17)	14	8	5; 8	3	7	3	4 (3:1)
Young Adults (i = 7)	6	2	1; 2	2	1	2	2 (2;0)
Total (i = 32)	22	11	(13;11)	5	8	10	9 (6:3)

Table 5
Evidence Map #4, Content of Motivational Brief Interventions.

	Adolescents (i = 7)	Emerging Adults (i = 15)	Young Adults (i = 6)	Total (i = 28)
Personalized feedback regarding…				
Frequency of Use	7 (100%)	11 (73%)	5 (83%)	23 (82%)
Consequences of Use	6 (86%)	9 (60%)	2 (33%)	17 (61%)
Normative Feedback	7 (100%)	8 (53%)	2 (33%)	17 (61%)
Risk of CUD	4 (57%)	7 (47%)	3 (50%)	14 (50%)
Motives for Use	0	4 (27%)	2 (33%)	6 (21%)
Any discussion of…				
Pros/Cons of use	7 (100%)	10 (67%)	4	20 (71%)
Values/Life Goals	7 (100%)	10 (67%)	2 (33%)	19 (68%)
Triggers or difficult situations	2 (29%)	4 (27%)	3 (50%)	9 (32%)
Other substance use	4 (57%)	4 (27%)	0	8 (29%)
Social Support or Interpersonal Issues	5 (71%)	2 (13%)	1 (17%)	8 (29%)
Readiness to or confidence in ability to change	1 (14%)	5 (33%)	2 (33%)	8 (29%)
Mental Health	0	3 (20%)	1 (17%)	4 (14%)
Role Plays	2 (29%)	0	1 (17%)	3 (11%)
Discussion of next steps pertaining to…				
Goal Setting	5 (71%)	10 (67%)	4 (67%)	19 (68%)
Additional Resources	6 (86%)	7 (47%)	6 (100%)	18 (64%)

between BI and passive control. No other studies measured CUD symptoms at longer-term follow-up. In summary, symptoms of CUD were significantly lower among individuals who received a BI compared to passive control at short-term follow-up, but these symptoms were not commonly measured at longer-term follow-up.

3.4.1.4. Cannabis abstinence. Pooling data from four interventions in three studies (n = 666)[4], there was a significant difference in the likelihood of abstinence at 3-month follow up between BI and passive control (OR 1.73 [95% CI 1.13 to 2.66]; $p = 0.01$; $I^2 = 0\%$) (See Fig. 7). Stein et al. (2011) did not report participant counts for sensitivity analyses, but using the three other interventions, effect estimates still favored BI although the effect was no longer significant (worst-case OR 1.06 [95% CI 0.41 to 2.70]; best-case OR 1.69 [95% CI 0.93 to 3.07]; n = 449). At other follow-up times, Stein et al. (2011) did not find significant differences at one or six months, but Bernstein (2009) found significantly higher abstinence rates among the BI group at 12-month follow-up. These results suggest that individuals who receive a BI are significantly more likely to be abstinent from cannabis at short-term follow-up, although this is based on a small number of studies.

3.4.1.5. Other substance use outcomes. Other substance use was less commonly measured and, when measured, differences favored the BI groups but often did not reach statistical significance. Where possible, studies were pooled. For alcohol outcomes, pooled effects were not significant at three or six months (3-month SMD −0.04 [95% CI −0.46 to 0.23]; n = 498; 6-month SMD −0.17 [95% CI −0.35 to 0.02]; n = 476). For other illicit drug use, two studies could be pooled yielding significant effects indicating reductions in the BI group (SMD −0.41 [95% CI −0.72 to −0.03]; $p < 0.001$; n = 303).

3.4.2. Help seeking, mental health, and functioning outcomes

Bernstein et al. (2009) found that individuals in the BI group were more likely to receive a referral to community resources compared to the usual care condition (OR 3.36 [95% CI 1.09 to 10.40]; $p < 0.05$). No other studies comparing BI to passive control reported on help-seeking or referral outcomes. No studies comparing BI to passive control reported any mental health or functioning outcomes.

3.4.3. Cannabis brief interventions compared to other interventions

Overall, nine studies compared cannabis BIs to other active interventions, eight of which compared two different BIs and one compared a BMI to a longer intervention. Overall, there is little existing evidence directly comparing BIs, but the existing evidence suggests: (1) no significant differences between online or written compared to in-person BIs (Fischer et al., 2013; Walton et al., 2013); (2) more comprehensive feedback may yield greater benefits (Copeland et al., 2017; Fernandes et al., 2010); (3) cannabis BMIs may yield greater benefits than psychoeducational BIs (Gee et al., 2014; Walker et al., 2011); and (4) cannabis-focused BIs may not outperform non-cannabis specific BIs (*e.g.*, general health feedback or relaxation strategies) (Fischer et al., 2013; Gee et al., 2014; Hernandez-Meier and Otto-Salaj, 2016; Riggs et al., 2018). Walker et al. (2016) compared a BMI to the same BMI plus three additional check-ins, revealing some differences between groups at six months follow-up, but overall both groups improved and reported similar engagement in subsequent help-seeking suggesting additional check-ins after a BI may not be necessary to achieve similar benefits.

[4] Stein reported the OR for using cannabis at follow-up and did not report any participant counts. The inverse of the OR and CI were taken to obtain an OR for abstinence at follow-up. The OR was rounded in the paper, so the closest estimate of the inverse to three decimal places was used in the meta-analysis. Also note ORs were not provided for one or six months and not included in a meta-analysis.

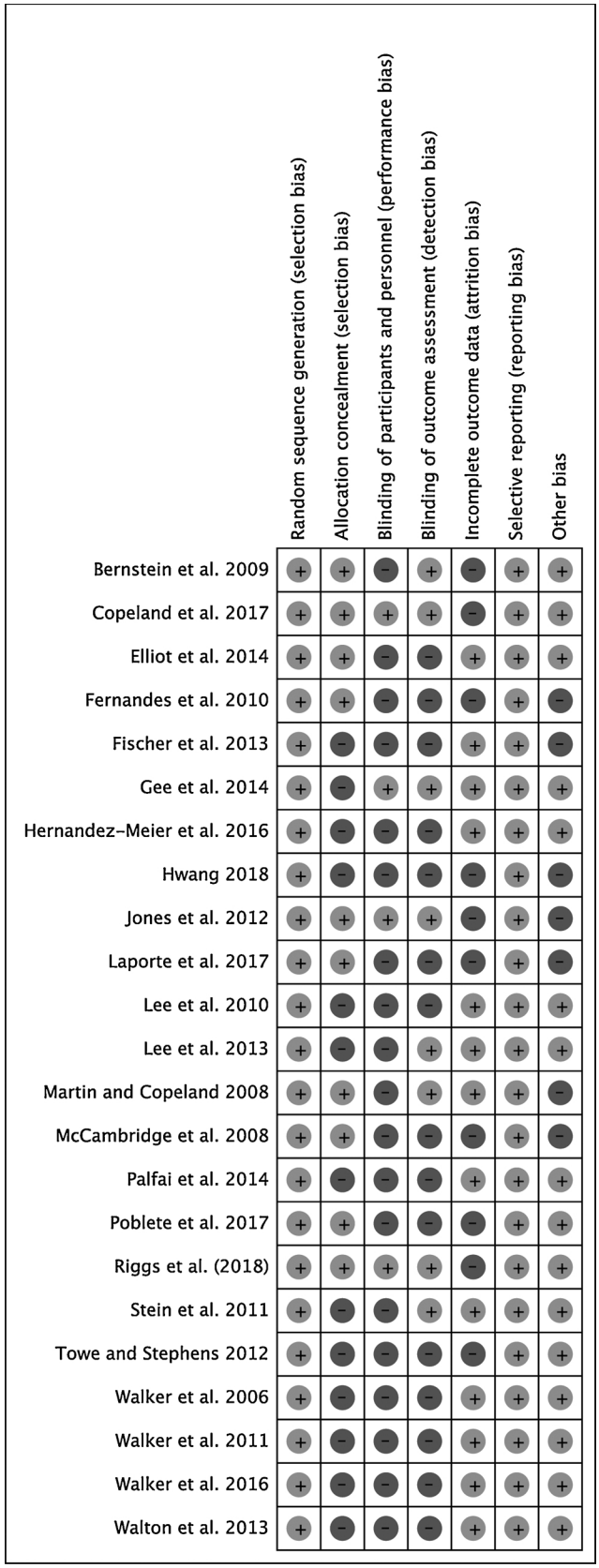

Fig. 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included randomized controlled trial.
This figure depicts the individual Risk of Bias assessment of each included randomized controlled trial according to domains in the Cochrane Risk of Bias tool.

3.4.4. Pre-post design studies

There were three studies that were evaluated as pre-post designs that all demonstrated significant improvements in cannabis-related outcomes (*i.e.*, cannabis frequency, use consequences, symptoms of CUD) (Feldstein et al., 2013; Sherman et al., 2017). Lang et al. (2000) was the only study to measure functional outcomes finding positive changes in in health, employment, interpersonal domains, and hobbies/sports at one month and three-months post-intervention. Overall, these results further indicate potential benefits of cannabis BIs for emerging adults.

3.4.5. Population characteristics

Due to the lack of statistical heterogeneity and inconsistent reporting, subgroup effects based on population characteristics were not tested. However, several studies did exploratory subgroup analyses based on sample characteristics. Regarding frequency of use or severity at baseline, one study found significant intervention effects for non-daily users but not daily users (Laporte et al., 2017), another found individuals who used more frequently had larger treatment effects (Gee et al., 2014), and two found baseline symptoms of CUD did not change treatment effects (Gee et al., 2014; Poblete et al., 2017). Higher baseline motivation to change was related to lower use at follow up, although motivation was not consistently found to moderate the response to BIs (Fernandes et al., 2010; Lee et al., 2010; Palfai et al., 2014; Stein et al., 2011; Towe and Stephens, 2012; Walker et al., 2006, 2011). Two studies explored family history of substance use problems, but results were inconsistent (Lee et al., 2010; Towe and Stephens, 2012). One study explored mental health concerns as a moderator, finding baseline scores did not change treatment effects (Gee et al., 2014). Three studies explored whether females responded more favorably than males, with mixed results (Fernandes et al., 2010; Elliott et al., 2014; Lee et al., 2010; Riggs et al., 2018). Overall, population characteristics which moderate treatment effects have not been thoroughly explored but the level of motivation to change at baseline may predict improvement at follow-up.

3.5. Quality of the evidence

The quality of the evidence included in these meta-analyses of BIs compared to passive control were low (abstinence) to very low (all other outcomes) (Table 6). All analyses were subject to moderate to high RoB as noted above. For primary outcomes, although statistical heterogeneity was low to absent (inconsistency graded as not serious), there was serious concern of indirectness. The content, delivery methods, and settings of the interventions differed contributing to down-grading for indirectness. Regarding precision of effect estimates, although not all effects reached statistical significance, point estimates often favored BIs and pooled confidence intervals failed to exclude clinically important benefits. Importantly, although pooled analyses met optimal information size criterion for each primary outcome, only one individual study was adequately powered to detect small differences in effects (Feldstein et al., 2013). Due to these small sample sizes, our ability to find small treatment effects, specifically for particular intervention and population characteristics, is limited. Considering publication bias, there were few large studies, potentially reflecting a lack of funding for large-scale clinical trials.

4. Discussion

This review presents a comprehensive systematic review, evidence map, and meta-analysis using rigorous methodology, focusing on the efficacy of cannabis BIs for emerging adults and related age groups (*i.e.*, older adolescence and young adulthood). The results indicate that, among non-treatment seeking emerging adults, existing BIs produce small reductions in symptoms of CUD and increase the likelihood of abstinence in the short term. Other cannabis and substance use related outcomes were reduced among those engaging in a BI, but the pooled

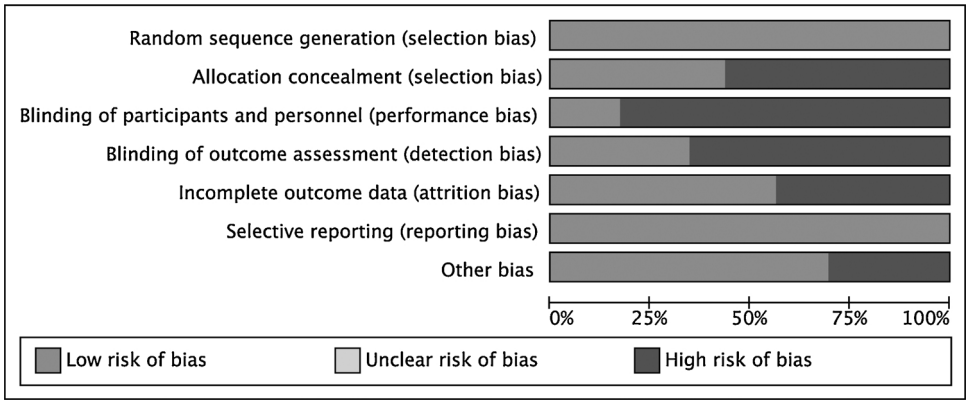

Fig. 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included randomized controlled trials.
This graph depicts the proportion of included randomized controlled trials judged as low and high risk of bias according to domains in the Cochrane Risk of Bias tool.

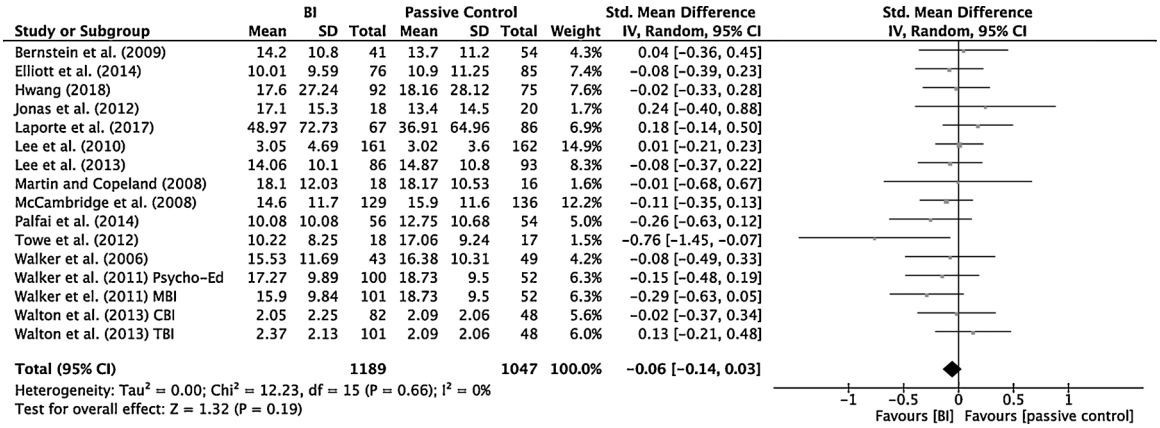

Fig. 4. BI versus Passive Control SMD Short Term Cannabis Use Frequency.
This figure depicts the forest plot for the meta-analysis of BIs compared to passive control on frequency of cannabis use assessed at short term (1–3 month) follow up. The standardized mean and confidence interval for each individual intervention is presented, with the pooled effect size depicted by the diamond at the bottom of the graph. Zero represents the line of no difference between BI and passive control. The left-hand side of the line of no difference favours the BI group.

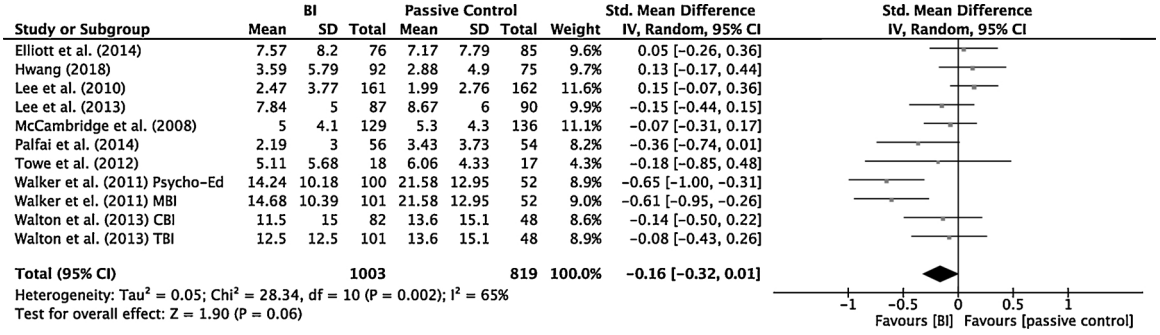

Fig. 5. BI versus Passive Control OR Short Term Cannabis Use Consequences.
This figure depicts the forest plot for the meta-analysis of BIs compared to passive control on cannabis use consequences assessed at short term (1–3 month) follow up. The standardized mean and confidence interval for each individual intervention is presented, with the pooled effect size depicted by the diamond at the bottom of the graph. Zero represents the line of no difference between BI and passive control. The left-hand side of the line of no difference favors the BI group.

estimates were typically not statistically significant and/or based on few studies.

The pooled effect sizes found in this review are modest, which is consistent with findings from related reviews (Imtiaz, et al., 2019; Li et al., 2019). Although longer-term psychosocial treatments likely yield larger effect sizes than BIs (Gates et al., 2016), such interventions are costly and time intensive. Given cannabis-related problems are often unrecognized and emerging adults are difficult to engage in longer-term treatments, BIs remain important to pursue despite modest effects, particularly given their potential application to large populations (Gulliver et al., 2010; Merikangas et al., 2011; Copeland et al., 2014). BIs also offer a first potential step along the continuum of care. Additionally, it should be noted that BIs for alcohol use, which have been more rigorously evaluated and are considered efficacious in reducing drinking among adults, also demonstrate only modest changes in use (Carey et al., 2007; O'Connor et al., 2018). Overall, despite small effect sizes, at this time, BIs should be considered an important component in a stepped approach to care for emerging adults who are using cannabis.

Most studies included in this analysis targeted individuals who were not seeking help for their cannabis use and who were not using

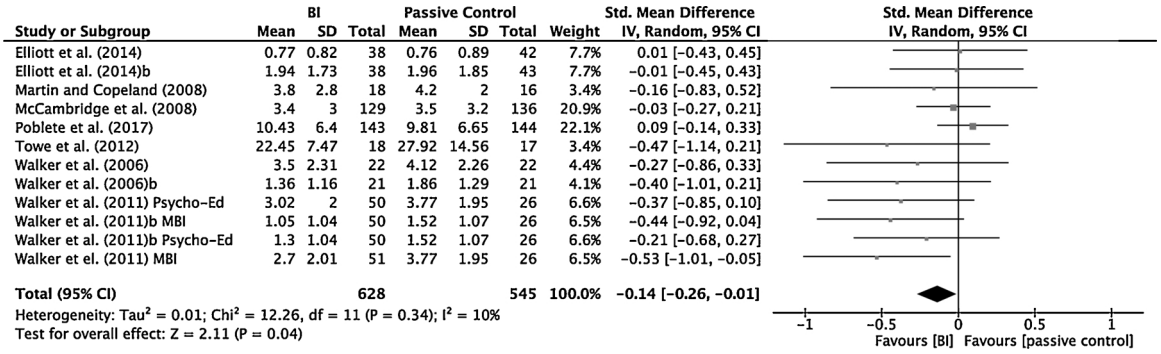

Fig. 6. BI versus Passive Control Short Term Symptoms of CUD (SMD).
This figure depicts the forest plot for the meta-analysis of BIs compared to passive control on symptoms of cannabis use disorders assessed at short term (1–3 month) follow up. The standardized mean and confidence interval for each individual intervention is presented, with the pooled effect size depicted by the diamond at the bottom of the graph. Studies with "b" indicate that two measures of cannabis use disorder (*i.e.* abuse, dependence, and/or CUD) were assessed and included in the meta-analysis. Zero represents the line of no difference between BI and passive control. The left-hand side of the line of no difference favours the BI group.

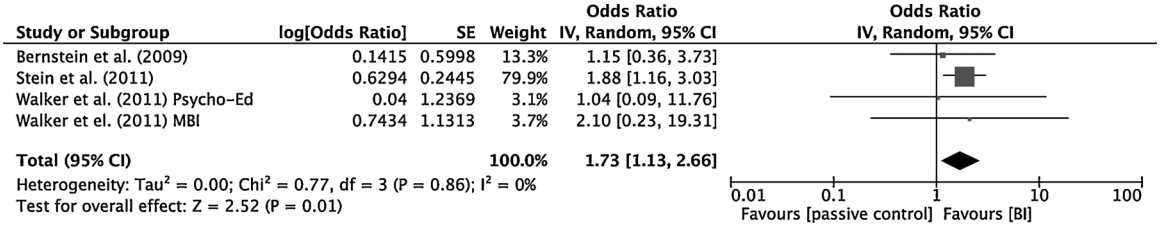

Fig. 7. BI versus Passive Control OR Short-Term Abstinence using the Generic Inverse Variance Method.
This figure depicts the forest plot for the meta-analysis of BIs compared to passive control on the odds of abstinence assessed at short term (1–3 month) follow up. One represents the line of no difference between BI and passive control. The right-hand side of the line of no difference favors the BI group.

cannabis at high frequencies. Individuals who use cannabis rarely seek help, and therefore problems related to cannabis use are often undetected (Copeland et al., 2014). The results of this review indicate BIs can be effective at an earlier stage along the continuum of cannabis use. Several included studies suggest baseline motivation to change is an important predictor of reductions in use and related problems at follow-up (Fernandes et al., 2010; Lee et al., 2010; Palfai et al., 2014; Stein et al., 2011; Towe and Stephens, 2012; Walker et al., 2006, 2011). In future studies of BIs, it will be important to consider targeting emerging adults who are using cannabis at higher frequencies and experiencing problems or consequences, as well as those who are motivated or are seeking help to change their cannabis use.

Cannabis use problems often co-occur alongside mental health concerns, and existing evidence indicates the need for concurrent and integrated treatment of both substance use and mental health concerns (Copeland et al., 2014). Cannabis users are at elevated risk of developing psychotic disorders (Moore et al., 2007; Mustonen et al., 2018) and evidence suggests that among individuals with depression or anxiety, concurrent use of cannabis is associated with greater severity of disorders and poorer response to treatment (Mammen et al., 2018). In this review, no studies were identified that targeted individuals with co-occurring mental health concerns, most studies did not screen for or measure comorbidity, and several explicitly excluded individuals with mental health concerns. Given that reduction in cannabis use has been associated with symptom improvement (Hser et al., 2017; Moitra et al., 2016; Jacobus et al., 2017), future studies should incorporate measures related to psychiatric symptomatology and target emerging adults with co-occurring or comorbid problems.

Results from these meta-analyses are of very low to low quality due to high risk of bias, imprecision, and indirectness. Trialists should seek to reduce bias by diligently reporting concealment methods, minimizing and accounting for attrition, and using urine drug screens, Time-Line Follow Back, and diagnostic interviews to reduce detection bias. Smartphone-based ecological momentary assessment approaches should also be considered as potential outcome measures (Shiffman, 2009). Similar to other reviews, these findings indicate a crucial need to fund and conduct adequately powered single, controlled studies so that small but meaningful effects can be captured (Li et al., 2019). Important outcomes beyond frequency of cannabis use need to be consistently assessed, such as mental health and functioning. Additionally, guidelines for clinically important changes in cannabis use and related outcomes need to be established to help determine and interpret meaningful effects.

Research assessing particular, promising intervention characteristics is warranted. Given that no subgroup difference was detected between in-person versus online interventions across meta-analyses, which has also been suggested in the alcohol BI literature (Carey et al., 2009), further study of online interventions is indicated given the probable economic advantages (Tait and Christensen, 2010). While existing evidence is sparse, motivational BIs may yield larger effects than psychoeducational BIs, but the specific ingredients which mediate these effects are important to isolate. There is also increasing interest in examining the effectiveness of alternative activities that facilitate drug-free reinforcement as a supplement or stand-alone alternative to typical cannabis interventions among emerging adults (McKay, 2017; Murphy et al., 2012, 2019; Stein et al., 2018). Of note, an example alternative activity intervention is the examination of values and life goals, which was incorporated into 68% of the motivational BIs in this review. Other alternative activities could include exercise and mindfulness interventions. Future studies should compare BIs of different types, with a particular focus on motivational BIs and alternative activities.

5. Conclusion

This review found that, among the population of non-treatment seeking emerging adults, when compared to no intervention or usual care, brief interventions resulted in significant reductions in symptoms of cannabis use disorder and an increased likelihood of cannabis abstinence, but did not have significant effects on cannabis frequency or cannabis use consequences. While the benefits were small, the overall

Table 6
GRADE Summary of Findings Table for BI versus Passive Control at 1–3month follow-up of cannabis-related primary outcomes.

	Certainty assessment							№ of patients		Effect	Certainty
	№ of studies	Study design	Risk of bias	Inconsistency	Indirect-ness	Imprecision	Other	BI	Passive Control	(95% CI)	
Frequency of Cannabis use (SMD)	16	RCTs	very serious [a]	not serious	serious[b]	serious[c]	none	1189	1047	SMD 0.06 lower (0.14 lower to 0.03 higher)	⨁◯◯◯ VERY LOW
Symptoms of Cannabis Use Disorder	13	RCTs	very serious[a]	not serious	serious[b]	serious[c]	none	628	545	SMD 0.14 lower (0.26 lower to 0.01 lower)	⨁◯◯◯ VERY LOW
Cannabis Consequences	12	RCTs	very serious[a]	not serious	serious[b]	serious[c]	none	1003	819	SMD 0.16 lower (0.32 lower to 0.01 higher)	⨁◯◯◯ VERY LOW
Likelihood of Abstinence	4	RCTs	serious[d]	not serious	serious[b]	not serious	none	369	297	OR 1.73 (1.13 to 2.66)	⨁⨁◯◯ LOW

CI: Confidence interval; **SMD:** Standardized mean difference; **OR:** Odds ratio Explanations.

[a] Poor description of allocation concealment, no patient blinding (difficult/impossible given nature of the intervention), self reported outcomes often not using gold standard assessment, high attrition in less than half of the studies, several did not monitor for fidelity to the intervention. Randomization appropriate and no apparent risk of selective reporting.

[b] Trials were of related, but different, interventions. Although all interventions were 1–2 sessions focusing on cannabis use and often the BI was motivational in nature, the content, delivery methods, and location of the intervention differed between studies.

[c] The CI includes estimates of clinically significant results and non-significant results. Therefore, the CI fails to exclude important benefit.

[d] Participants were not blind. 75% of interventions did not describe allocation concealment. 50% used appropriate data collection instruments although none used urinalysis. No evidence of selective reporting or other biases due to lack of fidelity/compliance.

quality of the evidence was low, and methodological limitations were present, this review and the gaps that it highlights indicate that brief interventions for cannabis use among emerging adults deserve further evaluation and development and remain important within a stepped care approach to substance use.

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Contributors

JH, JM, and CM conceived of and designed the review. JH led the screening, data extraction, data analysis, and writing of the review. JS was the primary second reviewer in screening, data extraction, analysis, and review. TP, VL, and RW also helped with data extraction and final reviews. CM is the senior author on this manuscript. All authors have reviewed and approve of the final submission.

Declaration of Competing Interest

No conflicts declared for all authors other than JM, who is a principal in BEAM Diagnostics, Inc.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2019.107565.

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