

doi: <https://doi.org/10.15446/rcp.v34n2.113988>

A Systematic Review of Randomized Controlled Trials for Behavioral Interventions Targeting Alcohol and Cannabis Use in Young Adults

ANGELA J PEREIRA-MORALES

Doctorado en Salud Pública, Facultad de Medicina, Universidad Nacional de Colombia

MARÍA FERNANDA REDONDO MAYORGA

Facultad de Ciencias Humanas, Universidad Nacional de Colombia

FELIPE RAMÍREZ-CORTÁZAR

Facultad de Ciencias Humanas, Universidad Nacional de Colombia

Universidad de Cundinamarca

JAVIER HERNANDO ESLAVA-SCHMALBACH

Facultad de Medicina, Universidad Nacional de Colombia



Excepto que se establezca de otra forma, el contenido de esta revista cuenta con una licencia Creative Commons “reconocimiento, no comercial y sin obras derivadas” Colombia 2.5, que puede consultarse en: <http://creativecommons.org/licenses/by-nc-nd/2.5/co>

How to cite this article: Pereira-Morales, A. J., Redondo Mayorga, M. F., Ramírez-Cortázar, F. & Eslava-Schmalbach, J. H. (2025). A Systematic Literature Review of Randomized Controlled Trials for Behavioral Interventions on Alcohol and Cannabis Use. *Revista Colombiana de Psicología*, 34(2), 59-77. <https://doi.org/10.15446/rcp.v34n2.113988>

Correspondence: Angela J Pereira-Morales (<https://orcid.org/0000-0003-2151-0424>). Email: apereira@unal.edu.co

SCIENTIFIC RESEARCH ARTICLE

RECEIVED: APRIL 18TH, 2024 - ACCEPTED: MAY 8TH, 2024

A Systematic Review of Randomized Controlled Trials for Behavioral Interventions Targeting Alcohol and Cannabis Use in Young Adults

Abstract

There is a wide range of behavioral interventions based on different theoretical approaches; some have shown some level of effectiveness in reducing cannabis and alcohol use rates, but few have been tested using a Randomized Controlled Trial (RCT) design. We searched MEDLINE, Embase, APA PSYCNET, and the Cochrane Central Register of Controlled Trials for RCTs published in English that examined behavioral interventions for cannabis and alcohol consumption. We screened 207 abstracts and identified 11 RCTs involving 4,211 young adults. Interventions with higher retention rates and statistically significant results were delivered in an online format and they were focused mostly on cannabis use reduction. Only the combination of motivational interviewing and behavioral economics showed significant results after follow-up, with a high retention rate. Integrating behavioral interventions embedded into public policies at institutional, local, or national levels could lead to more positive outcomes and long-term effectiveness. Applying these evidence-based interventions in public policy strategies could enhance long-term health outcomes and provide scalable solutions to address substance use among young adults.

Keywords: Alcohol Use; Cannabis Use; Young Adults; Behavioral Intervention; Randomized Controlled Trial.

Revisión Sistemática de Ensayos Aleatorios Controlados sobre Intervenciones Conductuales Dirigidas al Consumo de Alcohol y Cannabis en Adultos Jóvenes

Resumen

Existe una amplia gama de intervenciones conductuales basadas en diferentes enfoques teóricos; algunas han mostrado cierto nivel de eficacia en la reducción de las tasas de consumo de cannabis y alcohol, pero pocas se han probado mediante un diseño de Ensayo Controlado Aleatorio (ECA). Se realizaron búsquedas en MEDLINE, Embase, APA PSYCNET y en el Registro Cochrane Central de Ensayos Controlados (Cochrane Central Register of Controlled Trials) de ECA, publicados en inglés, que examinaran intervenciones conductuales para el consumo de cannabis y alcohol. Se examinaron 207 resúmenes y se identificaron 11 ECA con 4 211 adultos jóvenes. Las intervenciones con mayores tasas de retención y resultados estadísticamente significativos se administraron en formato en línea y se centraron en la reducción del consumo de cannabis. Solo la combinación de entrevista motivacional y economía conductual mostró resultados significativos tras el seguimiento, con una elevada tasa de retención. La integración de las intervenciones conductuales en las políticas públicas a nivel institucional, local o nacional podría dar lugar a resultados más positivos y a una mayor eficacia a largo plazo. La aplicación de estas intervenciones basadas en la evidencia en las estrategias de políticas públicas podría mejorar los resultados de salud a largo plazo y proporcionar soluciones escalables para abordar el consumo de sustancias entre los adultos jóvenes.

Palabras clave: Consumo de alcohol; Consumo de cannabis; Adultos jóvenes; Intervención conductual; Ensayo controlado aleatorizado.

Introduction

Substance use among young adults is considered a significant public health concern. According to the World Drug Report (WDR) 2021, about 275 million people worldwide used drugs. This number increased by 22%, globally, between 2010 and 2019 (UNODOC, 2021). During the COVID-19 pandemic, patterns of substance use changed among young adults, leading to increased alcohol consumption being attributed to circumstances such as employment loss and feelings of loneliness. However, vulnerability related to cannabis and alcohol consumption among this group remained stable throughout the pandemic (Pocuca et al., 2022).

Young adults represent a critical population group as they are crossing life milestones such as starting university, forming intimate relationships, and in many cases the beginning of working life. That period of their lives may be associated with increased risks related to access to substance use, emotional changes, and the importance given to peers (Steinberg, 2018).

Given these characteristics, interventions for substance use is mainly on the reduction of harm and prevention rather than intensive treatment, which is more frequent in the adult population (Stockings et al., 2016). Taking that into account, educational settings can be a more suited way to deliver early interventions for young adults, as well as mobile and online interventions that might be more appropriate and more easily adopted by this specific population group (Hall et al., 2016). The above could represent an additional advantage: that kinds of interventions are less expensive than intensive treatments for dependent users and could result in a more significant long-term public health impact (Levin & Chisholm, 2016).

A key challenge of existing behavioral interventions is their long-term effectiveness. For example, substance use prevention programs have shown a certain level of effectiveness,

although their long-term impact is still uncertain (Stockings et al., 2016).

Other programs such as brief interventions, personalized individual interventions, motivational enhancement therapy, and motivational interview, have demonstrated small effects on alcohol consumption in young adults (Carey et al., 2009; Foxcroft et al., 2016); however, its long-term efficacy remains unproved (Patton et al., 2014). Motivational interview (MI) approaches are by far the most used preventive interventions for substance use in the young population. However, a review of 21 controlled studies examining the motivational interview for alcohol use and illicit substances in young adults reported a small average effect size with large uncertainty (Jensen et al., 2011).

On the other hand, behavioral economics (BE) has emerged as a promising approach for understanding decision-making related to substance use and designing interventions. BE research suggests that substance use is an inverse function of limited access to the substance and a direct function of limited access to alternative rewards (Bickel et al., 2014).

MI and BE represent two complementary frameworks that have proven effective in addressing substance use among young adults (Ladd et al., 2021; Murphy & Dennhardt, 2016; Smedslund et al., 2011). MI fosters an empathetic, client-centered environment that encourages young adults to explore their motivations and recognize discrepancies between substance use and personal goals. In contrast, BE suggests that young adults' decisions substance use is influenced by factors such as the availability and cost of alcohol and cannabis, the presence of substance-free alternative activities, and the relative devaluation of substance-free rewards compared to the immediate reinforcement provided by drug use.

Several studies have demonstrated the outperforming effect of BE to reduce cannabis and alcohol consumption, in comparison with

control conditions such as waitlist, placebo, or treatment as usual (Davis et al., 2015; Steele et al., 2020). For instance, it has been implemented the use of substance-free reinforcement and salience of delayed rewards with success (Murphy et al., 2012). Other programs have aimed to increase other reinforcements' value instead of substance use (Mackillop, 2016).

The current systematic review included some of the most used psychosocial interventions as well as BE interventions for alcohol and cannabis reduction. Considering that psychosocial interventions for the intervention of alcohol and cannabis use covered many treatment interventions and are based on varied theoretical backgrounds of psychosocial interventions, we selected those considered evidence based. This systematic review considered the following aspects: 1) the increasing rates of alcohol and cannabis use among young adults leads to the imperative need for proven behavioral interventions (Manthey, 2019); 2) many of the interventions available for alcohol and cannabis consumption lack replicability standards (Miller & Rollnick, 2014); 3) the absence of evidence about long-term effectiveness.

This study aimed to identify and compare published RCTs that evaluated behavioral interventions designed to reduce alcohol and cannabis consumption among young adults. The novelty of this systematic review relies on the fact that there are no published reviews including strictly RCTs comparing psychosocial interventions for alcohol and cannabis use reduction in the young adult population.

Methods

It was conducted a systematic review following the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) (Liberati et al., 2009).

As a first step, it was explored the International Prospective Register of Systematic Reviews (PROSPERO) to ensure that no similar

reviews were in progress. The review protocol was registered in the PROSPERO database (registration number CRD42020161027).

Psychosocial interventions terms

As we mentioned earlier, we selected those interventions that have shown effectiveness and are considered "evidence-based". Therefore, terms used were: "education", "mindfulness", "counseling", "educative sessions", "mindfulness-based meditation for substance use", "drug counselling", "skills-based interventions", and "personalized normative feedback".

Besides, it was choosing the term "behavioral economics" to expand the concept and it was added related concepts such as "delay discounting", "reinforcement", "contingency management", "delayed reward discounting", "temporal discounting", "community reinforcement approach".

Search strategy

We employed the PICOS approach and Boolean search methods (AND, OR, NOT) using a combination of MeSH, DeCS, and Emtree terms, and freetext terms were used.

The complete search strategies for all databases are available in the supplementary material (Table S1). We searched MEDLINE, Embase, APA PSYCNET, and the Cochrane Central Register of Controlled Trials in December 2021. Our search included articles from inception until December 2021, then the search was augmented using references from included articles.

Eligibility criteria

Published primary research articles were included if they met the following inclusion criteria: (i) the study design was either randomized and controlled or controlled before-after; (ii) the study included young adults aged 18 to 25 years who reported alcohol and/or cannabis use. It is important to note that the search was not restricted to this age group; however, the

included studies must have intervened population including people 18 to 25 years old; (iii) studies published in English: (i) the full text was not available; (ii) the study was a protocol or a secondary study; (iii) the included population met the diagnostic criteria for substance use disorder; and (iv) the reported substance use involved substances other than alcohol and cannabis. Additionally, a pilot test of the eligibility criteria was conducted to refine the methodology before full implementation.

Data extraction and analysis

All studies were imported into Mendeley reference management software, and duplicates were removed. Three independent reviewers (AJPM, MRM, FRC) conducted a title screen, thereafter the same three reviewers did a screening of the abstracts and full texts of the remaining studies and documented reasons for exclusion. Two reviewers (MRM, FRC) independently extracted and screened the data, resolving any discrepancies through consensus. In instances where disagreement persisted, a fourth reviewer (JHES) was consulted to ensure objectivity in the selection process.

It was developed a standardized data extraction form in Microsoft Excel based on the Cochrane Effective Practice and Organization of Care (EPoC) form (Cochrane Effective Practice and Organisation of Care (EPoC), 2017).

Collected data included study context, population, research design, intervention, outcomes, and results. After identifying the main types of interventions, studies were categorized based on whether they followed a behavioral economics approach or based on a different theoretical framework.

The included studies were highly heterogeneous in terms of implementation, delivery type, measurement variables, and statistical analyses. However, it was possible to identify two broad categories of interventions: those based on behavioral economics and those based on other

well-established psychosocial interventions for reducing alcohol and cannabis use.

A narrative synthesis was conducted by comparing interventions based on behavioral economics and interventions based on some of the most used psychosocial interventions for substance use reduction.

Quality assessment

Included studies were assessed for methodological quality and risk of bias using the revised Cochrane Risk-of-Bias tool for randomized trials (RoB 2) tool (Sterne et al., 2019). Each study received a global score of high risk, some concern, or low risk of bias. The assessment visualization was performed using the Risk-of-bias visualization (robvis) tool (McGuinness & Higgins, 2020).

Results

Of the 232 citations retrieved, 11 randomized controlled trials (RCTs) involving 4,211 participants met the prespecified inclusion criteria and were included in the review (Figure 1). Information on excluded papers is provided in the supplementary material (Table S2). It is important to note that only 232 potential papers were retrieved because we just wanted to include randomized controlled trials, and the literature employing this experimental design in this field is relatively scarce.

Description of studies

Table 1 provides an overview of the included studies. Sample sizes ranged from 63 to 1,292 participants, whose mean age ranged from 18 to 39 years, and 44.6% were female.

Most studies were based on or incorporated motivational interviewing as the primary intervention ($n = 9$). The remaining studies included motivational enhancement therapy ($n = 1$) and self-regulation and self-control interventions ($n = 1$). The comparators were mostly no intervention (assessment only) ($n = 5$), followed by

education sessions ($n = 1$), treatment resource referrals ($n = 3$), usual treatment ($n = 1$), and waitlist control ($n = 1$). Eight studies focused exclusively on cannabis use, one on alcohol use, and two on both alcohol and cannabis use.

The primary outcomes assessed were substance use frequency ($n = 9$) and complete abstinence ($n = 1$). All studies reported post-intervention effects and follow-up data ranged from 2 to 48 weeks.

Methodological quality of the studies

Figure 2 shows that 81.8% of the studies were rated at low risk for selection bias (i.e., random sequence generation), 63.6% of the studies reached a low risk regarding selective outcome reporting, and 54.5% reached a low risk regarding allocation concealment. In the other domains, low risk related to attrition bias (i.e., incomplete outcome data) was achieved in 45.4% of the studies, low risk in performance bias (i.e., Blinding of participants and personnel) was attained by 36.3% and only 18.1% reached a low risk in detection bias (i.e., Blind outcome assessment). Otherwise, low risk in other sources of bias was achieved by 100% of the studies. Furthermore, only a study was rated at high risk regarding performance bias, however, it was included in the review due to this same study was rated at low risk on attrition bias, selective outcome reporting, and other sources of bias.

Characteristics of the interventions

Most interventions were brief versions with lengths ranging from one single session to multiple sessions up to 50 days of follow-up. Regards to retention rates, the combination of brief negotiated interview (BNI) with motivational interviewing (MI) (Fuster et al., 2016) achieved a higher retention rate (98%), followed by peer network counseling-txt (PNC-txt) based on motivational enhancement therapy (MET) (M. J. Mason et al., 2018) and, web personalized feedback (WEB-PFI) based on MI (Lee et al.,

2010) which achieved a retention rate of 95% and 94% respectively (Table 1).

The combination of brief motivational interview (BMI) and substance-free activity sessions (SFAS) (Dennhardt et al., 2015), MI alone (McCambridge et al., 2008), and BMI (McCambridge et al., 2008) achieved acceptable retention rates of 88%, 80%, and 73% respectively. Otherwise, the combination of personalized feedback intervention with strategies to manage negative affect (PFI-NAC) (Buckner et al., 2020), FRAMES which is based on MI (Laporte et al., 2017), self-regulation and self-control (Tossmann et al., 2011) and BMI (Signor et al., 2013) achieved poor retention rates of 62%, 51%, 28% and, 22% respectively (Table 1).

Regarding effectiveness, only 3 studies reported statistically significant differences for pre and post-intervention measurements and reported high retention rates (PNC-txt, PFI-NAC, and BMI plus SFAS) (Buckner et al., 2020; Dennhardt et al., 2015; M. J. Mason et al., 2018); nevertheless, the study with the combination of MI and BE showed evidence of high-risk of performance bias (Dennhardt et al., 2015). Two studies reported statistically significant differences but with low retention rates (BMI, and self-regulation plus self-control) (Signor et al., 2013; Tossmann et al., 2011). The study using BMI for alcohol use reduction reported significant results but a very low retention rate (23%) (Signor et al., 2013). It is important to note that both studies were brief versions with a length of 1 session and seven sessions respectively.

Table 2 describes the characteristics of interventions. It is important to note that the interventions that reported higher retention rates and statistically significant results were delivered in an online format and they were focused mostly on cannabis use reduction (Buckner et al., 2020; Dennhardt et al., 2015; M. J. Mason et al., 2018). As well as the interventions that reported statistical effectiveness

but with low retention rates, were also delivered in a format different from the face-to-face one, and they were focused on alcohol use reduction and cannabis use reduction (Signor et al., 2013; Tossmann et al., 2011).

In addition, of the interventions that reported having provided any economic or academic incentive for participation, one reported a high retention rate (95%) and also effectiveness (M. J. Mason et al., 2018), one reported effectiveness and low retention rate (62%) (Buckner et al., 2020), and one also reported effectiveness but very low retention rate (26.1%) (Tossmann et al., 2011). Otherwise, two interventions delivering economic incentives reported a high retention rate (94% and 80%) but no effectiveness (Lee et al., 2010; McCambridge et al., 2008).

Lastly, most interventions were delivered by health professionals with training in the theoretical approach underlying the intervention. Additionally, none of the included studies used BE interventions alone; instead, four studies incorporated BE in combination with MI. One study combined BMI with SFAS, while the remaining studies utilized BMI alone.

The majority of interventions including BE reported good to acceptable retention rates, ranging from 88% to 79%, with only one study reporting a very low retention rate (23%). Moreover, many of these interventions were delivered in a face-to-face format.

In summary, this systematic review identified 11 randomized controlled trials involving 4,211 participants, primarily employing motivational interviewing as the intervention. The studies demonstrated varying sample sizes and retention rates, with online interventions showing higher retention and statistically significant effects on cannabis use reduction compared to face-to-face approaches. Most studies exhibited a low risk of selection bias, underscoring their methodological rigor. These findings suggest that integrating motivational interviewing and behavioral economics can be

an effective approach to addressing substance use among young adults, warranting further exploration and application in clinical settings.

Discussion

This review identified motivational interviewing (MI) as the most commonly used approach for reducing cannabis and alcohol use among young adults. It was also usual that the interventions were typically brief versions (BI), lasting generally one session, and the online format was as popular as the in-person interventions. The popularity of these characteristics may be attributed to their ease of implementation and low cost.

Among the reviewed studies, just three reported significant results and one of them was rated as high risk due to performance bias. Two had significant results but with low retention rates, besides three of the reviewed papers had very low retention rates (23%, 26.1%, and 55.7%). Notably, two of those studies include BE in the intervention program. The study combining BMI and SFAS for cannabis and alcohol use reduction (Dennhardt et al., 2015) and the study using BMI for alcohol use reduction (Signor et al., 2013); of them had a short length.

However, the evidence regarding the effectiveness of MI and BE interventions remain inconclusive. While some studies reported significant substance use reduction and high retention rates, others using the same theoretical approach and of similar length did not yield significant results. This inconsistency makes it difficult to determine whether MI alone or in combination with BE in a brief format is an effective intervention for alcohol and cannabis reduction. Further research is needed to confirm its efficacy.

The evidence is so far discordant, that previous systematic reviews have reported the effectiveness of BMI on excessive alcohol use (Vasilaki et al., 2006) but not on cannabis use (Li et al., 2016), and a review of reviews reported

a certain level of effectiveness for both alcohol and illicit drug use (Frost et al., 2018).

Even with that, it could be considered that Behavioral economics (BE) approaches were the most effective. BE theorizes that decisions to use psychoactive substances are a function of the benefit/cost ratio of substance use concerning the benefit/cost ratio of substance-free activities. Substance use is explained by a pattern of a marked preference for small, immediate rewards vs. larger but delayed rewards (Murphy & Dennhardt, 2016). In addition, the interaction between endogenous effects of the substance and contextual factors including substance monetary and not monetary prices, low availability of alternatives free of substances, stressful situations, and social incentives, are also part of the substance use behavior explanation (Skidmore et al., 2014).

Based on the above, a large group of BE interventions has been focused on offering alternative monetary reinforcers in explicit competition with substance use. Other groups of interventions have used alternatives to substance use like engagement in social reinforcement activities, exercise and academic activities, and training to reduce temporal discounting (Bentzley et al., 2013). Recently, brief motivational interventions (BMIs) have incorporated BE standards by providing feedback on time allocation for substance use compared to other beneficial activities (e.g., family, friends, academics, exercise), which may offer a greater opportunity-cost of substance consumption (Ladd et al., 2021).

It is important to note that even though a large sample size was included across 11 studies ($N = 4,211$), only a few studies demonstrated effectiveness. For example, although several studies recognized a limitation in the lack of biochemical validation of the substance consumption reports, most of the reviewed articles' results are based only on self-report instruments. Though, this decision may be attributed to

the high cost of biochemical assessments, it may introduce bias and reduce the reliability of findings.

On the other hand, many of the included studies in the current review reflected the lack of participants' variety in terms of relevant sociodemographic factors, since most of them were mainly male university students. Include gender differences, and social and contextual variables in the analysis should be considered as relevant to prove the reliability and validity of these interventions (McDermott et al., 2013; W. A. Mason et al., 2009).

The above also relates to the lack of studies targeting to concomitant use of alcohol and cannabis. The included interventions were directed mostly to cannabis consumers, despite alcohol being one of the most consumed substances worldwide and better interventions are also needed urgently to reduce hazardous alcohol use in young adults (Garcia-Cerde et al., 2021). Besides, strategies to achieve higher retention rates are also necessary. Most of the included studies had a follow-up rate below 40% which represent a deficiency in generalization (Dalton et al., 2021).

Thus, our findings indicate the following as the interventions with the greatest potential to achieve retention rates: 1) the combination of the brief negotiated interview with motivational interviewing for cannabis use, 2) peer network counseling-txt based on motivational enhancement therapy for cannabis use, 3) web personalized feedback based on motivational intervention for cannabis use (Fuster et al., 2016; Lee et al., 2010; M. J. Mason et al., 2018). Moreover, two of them were applied under an online approach (Lee et al., 2010; M. J. Mason et al., 2018).

As has been pointed out in a previous systematic review focused on online interventions for cannabis use, targeted interventions may include peer support and regular feedback to achieve increased adherence as well

as user-centered design procedures (Beneria et al., 2021). The results of the current systematic review support in part that statement, since peer network counseling-txt and personalized feedback intervention plus strategies to manage negative affect, reported positive results and, they were delivered using an online format.

A previous study about the risk of bias assessment of behavioral clinical trials included in systematic reviews for substance use agreed on the need for rigorous research since the risk of bias assessments is usually high (Bo et al., 2021). In our revision, incomplete outcome data bias and blinding of outcome assessment bias were the most concerning biases, thus future RCTs on behavioral interventions for substance use should try to address this issue to achieve better accuracy of results.

The practical perspective, interventions integrating BE principles should be prioritized, as they encourage engagement in substance-free activities. Policymakers can support the development and dissemination of these evidence-based interventions by providing funding and promoting them through public health campaigns on digital platforms, which have proven to be both effective and cost-efficient. Furthermore, incorporating diverse social contexts and implementing comprehensive follow-up strategies may improve intervention accessibility and retention. Addressing these aspects systematically could lead to more robust strategies for reducing substance use among young adults.

Limitations

Despite efforts to include most of the available evidence in this review, limitations related to the systematic review methodology must be considered. First, some authors included substances other than alcohol and cannabis but did not differentiate the results by substance. Consequently, such studies were excluded from this review, despite the potential relevance of their findings.

Additionally, significant heterogeneity among the included studies presents a challenge to draw conclusions. The interventions varied in theoretical underpinnings, including MI, BE approaches, or combinations of both, each influencing retention and effectiveness differently. For instance, studies that combined MI with BE produced mixed results in terms of retention and effectiveness, as seen in interventions such as brief negotiated interviews (BNI) and personalized feedback.

Furthermore, the studies differed substantially in design and implementation, with intervention lengths ranging from a single session to multiple weeks, and follow-up periods extending from 2 to 48 weeks. Such methodological diversity complicates efforts to compare and generalize outcomes uniformly. Otherwise, it is important to consider that most of the analyzed studies were conducted in developed countries. Moreover, the review only included literature published in English, potentially overlooking relevant studies published in other languages and targeting different populations.

Conclusions

This systematic review aimed to identify and compare published RCTs assessing some of the most commonly used psychosocial interventions for substance use reduction, particularly those considered “evidence-based” for reducing alcohol and cannabis consumption in young adults. Overall, findings suggest that MI in combination with BE appears to be the most effective approach. Additionally, interventions delivered online and in brief formats may improve retention rates. However, the presence of high risk of bias reduces confidence in these conclusions.

On the other hand, the few papers included showed that RCT is not the usual design implemented to assess behavioral intervention effectiveness for alcohol and cannabis use

reduction, thus quasi-experimental design is a more frequently used design.

The scarcity of significant results suggests that interventions need to be more engaging, specific, and targeted to effectively promote alcohol and cannabis use reduction among young adults. Moreover, embedding behavioral interventions into public policies at institutional, local, or national levels could enhance both short- and long-term effectiveness.

Finally, this is the first systematic review focused on RCTs assessing behavioral interventions for reducing cannabis and alcohol use in young adults. It provides insights into both the strengths and limitations of the current behavioral interventions. Future studies should include behavioral interventions from a public policy perspective; thus, this would provide better information on the effectiveness of these interventions at the public health level.

Role of funding sources

Universidad Nacional de Colombia supports JHES. Ministry of Science, Technology, and Innovation (MINCIENCIAS) - Young Scientist Program Supports MFR and FRC. Universidad Nacional de Colombia had no role in the study design, collection, analysis, or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

Acknowledgement

We wish to acknowledge Equity in Health Research Group members for their valuable discussions on the manuscript.

Disclosures

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Beneria, A., Santesteban-Echarri, O., Daigre, C., Tremain, H., Ramos-Quiroga, J. A., McGorry, P. D., & Alvarez-Jimenez, M. (2021). Online interventions for cannabis use among adolescents and young adults: Systematic review and meta-analysis. *Early Intervention in Psychiatry*, eip.13226. <https://doi.org/10.1111/eip.13226>
- Bentzley, B. S., Fender, K. M., & Aston-Jones, G. (2013). The behavioral economics of drug self-administration: A review and new analytical approach for within-session procedures. *Psychopharmacology*, 226(1), 113–125. <https://doi.org/10.1007/s00213-012-2899-2>
- Bickel, W. K., Johnson, M. W., Koffarnus, M. N., MacKillop, J., & Murphy, J. G. (2014). The Behavioral Economics of Substance Use Disorders: Reinforcement Pathologies and Their Repair. *Annual Review of Clinical Psychology*, 10(1), 641–677. <https://doi.org/10.1146/annurev-clinpsy-032813-153724>
- Bo, A., Hai, A. H., Chen, D.-G., & Hammock, K. (2021). Risk of bias assessments in systematic reviews and meta-analyses of behavioral interventions for substance use outcomes. *Journal of Clinical Epidemiology*, 139, 20–27. <https://doi.org/10.1016/j.jclinepi.2021.06.012>
- Buckner, J. D., Zvolensky, M. J., & Lewis, E. M. (2020). On-line personalized feedback intervention for negative affect and cannabis: A pilot randomized controlled trial. *Experimental and Clinical Psychopharmacology*, 28(2), 143–149. <https://doi.org/10.1037/pha0000304>
- Carey, K. B., Scott-Sheldon, L. A. J., Elliott, J. C., Bolles, J. R., & Carey, M. P. (2009). Computer-delivered interventions to reduce college student drinking: A meta-analysis. In *Addiction*, 104(11), 1807–1819. <https://doi.org/10.1111/j.1360-0443.2009.02691.x>
- Cochrane Effective Practice and Organisation of Care (EPOC). (2017). *Data collection form*. EPOC Resources for review authors, 2017. <https://epoc.cochrane.org/epoc-taxonomy>
- Dalton, K., Bishop, L., & Darcy, S. (2021). Investigating interventions that lead to the highest treatment retention for emerging adults with substance use

- disorder: A systematic review. *Addictive Behaviors*, 122. <https://doi.org/10.1016/j.addbeh.2021.107005>
- Davis, M. L., Powers, M. B., Handelsman, P., Medina, J. L., Zvolensky, M., & Smits, J. A. J. (2015). Behavioral Therapies for Treatment-Seeking Cannabis Users: A Meta-Analysis of Randomized Controlled Trials. *Evaluation and the Health Professions*, 38(1), 94–114. <https://doi.org/10.1177/0163278714529970>
- Dennhardt, A. A., Yurasek, A. M., & Murphy, J. G. (2015). Change in delay discounting and substance reward value following a brief alcohol and drug use intervention. *Journal of the Experimental Analysis of Behavior*, 103(1), 125–140. <https://doi.org/10.1002/jeab.121>
- Foxcroft, D. R., Coombes, L., Wood, S., Allen, D., Almeida Santimano, N. M. L., & Moreira, M. T. (2016). Motivational interviewing for the prevention of alcohol misuse in young adults. In *Cochrane Database of Systematic Reviews*, 2016(7). <https://doi.org/10.1002/14651858.cd007025.pub4>
- Frost, H., Campbell, P., Maxwell, M., O'Carroll, R. E., Dombrowski, S. U., Williams, B., Cheyne, H., Coles, E., & Pollock, A. (2018). Effectiveness of Motivational Interviewing on adult behaviour change in health and social care settings: A systematic review of reviews. *PLOS ONE*, 13(10). <https://doi.org/10.1371/journal.pone.0204890>
- Fuster, D., Cheng, D. M., Wang, N., Bernstein, J. A., Palfai, T. P., Alford, D. P., Samet, J. H., & Saitz, R. (2016). Brief intervention for daily marijuana users identified by screening in primary care: A subgroup analysis of the ASPIRE randomized clinical trial. *Substance Abuse*, 37(2), 336–342. <https://doi.org/10.1080/08897077.2015.1075932>
- Garcia-Cerde, R., Valente, J. Y., Sohi, I., Falade, R., Sanchez, Z. M., & Monteiro, M. G. (2021). Alcohol use during the COVID-19 pandemic in Latin America and the Caribbean. *Revista Panamericana de Salud Publica/Pan American Journal of Public Health*, 45. <https://doi.org/10.26633/rpsp.2021.52>
- Hall, W. D., Patton, G., Stockings, E., Weier, M., Lynskey, M., Morley, K. I., & Degenhardt, L. (2016). Why young people's substance use matters for global health. *The Lancet Psychiatry*, 3(3), 265–279. [https://doi.org/10.1016/S2215-0366\(16\)00013-4](https://doi.org/10.1016/S2215-0366(16)00013-4)
- Jensen, C. D., Cushing, C. C., Aylward, B. S., Craig, J. T., Sorell, D. M., & Steele, R. G. (2011). Effectiveness of motivational interviewing interventions for adolescent substance use behavior change: A meta-analytic review. *Journal of Consulting and Clinical Psychology*, 79(4), 433–440. <https://doi.org/10.1037/a0023992>
- Ladd, B. O., Murphy, J. G., & Borsari, B. (2021). Integration of motivational interviewing and behavioral economic theories to enhance brief alcohol interventions: Rationale and preliminary examination of client language. *Experimental and Clinical Psychopharmacology*, 29(1), 90–98. <https://doi.org/10.1037/pha0000363>
- Laporte, C., Vaillant-Roussel, H., Pereira, B., Blanc, O., Eschalier, B., Kinouani, S., Brousse, G., Llorca, P.-M., & Vorilhon, P. (2017). Cannabis and Young Users —A Brief Intervention to Reduce Their Consumption (CANABIC): A Cluster Randomized Controlled Trial in Primary Care. *The Annals of Family Medicine*, 15(2), 131–139. <https://doi.org/10.1370/afm.2003>
- Lee, C. M., Neighbors, C., Kilmer, J. R., & Larimer, M. E. (2010). A brief, web-based personalized feedback selective intervention for college student marijuana use: A randomized clinical trial. *Psychology of Addictive Behaviors*, 24(2), 265–273. <https://doi.org/10.1037/a0018859>
- Levin, C., & Chisholm, D. (2016). Cost-effectiveness and affordability of interventions, policies, and platforms for the prevention and treatment of mental, neurological, and substance use disorders. *Mental, Neurological, and Substance Use Disorders: Disease Control Priorities*, 4(3), 219–236.
- Li, L., Zhu, S., Tse, N., Tse, S., & Wong, P. (2016). Effectiveness of motivational interviewing to reduce illicit drug use in adolescents: a systematic review and meta-analysis. *Addiction*, 111(5), 795–805. <https://doi.org/10.1111/add.13285>
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009).

- The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Medicine*, 6(7), e1000100. <https://doi.org/10.1371/journal.pmed.1000100>
- Mackillop, J. (2016). The Behavioral Economics and Neuroeconomics of Alcohol Use Disorders. *Alcoholism: Clinical and Experimental Research*, 40(4), 672–685. <https://doi.org/10.1111/acer.13004>
- Manthey, J. (2019). Cannabis use in Europe: Current trends and public health concerns. *International Journal of Drug Policy*, 68, 93–96. <https://doi.org/10.1016/j.drugpo.2019.03.006>
- Mason, M. J., Zaharakis, N. M., Moore, M., Brown, A., Garcia, C., Seibers, A., & Stephens, C. (2018). Who responds best to text-delivered cannabis use disorder treatment? A randomized clinical trial with young adults. *Psychology of Addictive Behaviors*, 32(7), 699–709. <https://doi.org/10.1037/adb0000403>
- Mason, W. A., Kosterman, R., Haggerty, K. P., Hawkins, J. D., Redmond, C., Spoth, R. L., & Shin, C. (2009). Gender moderation and social developmental mediation of the effect of a family-focused substance use preventive intervention on young adult alcohol abuse. *Addictive Behaviors*, 34(6–7), 599–605. <https://doi.org/10.1016/j.addbeh.2009.03.032>
- McCambridge, J., Slyn, R. L., & Strang, J. (2008). Randomized controlled trial of motivational interviewing compared with drug information and advice for early intervention among young cannabis users. *Addiction*, 103(11), 1809–1818. <https://doi.org/10.1111/j.1360-0443.2008.02331.x>
- McDermott, M. J., Drescher, C. F., Smitherman, T. A., Tull, M. T., Heiden, L., Damon, J. D., Hight, T. L., & Young, J. (2013). Prevalence and Sociodemographic Correlates of Lifetime Substance Use Among a Rural and Diverse Sample of Adolescents. *Substance Abuse*, 34(4), 371–380. <https://doi.org/10.1080/08897077.2013.776000>
- McGuinness, L. A., & Higgins, J. P. T. (2020). Risk-of-bias visualization (robvis): An R package and Shiny web app for visualizing risk-of-bias assessments. *Research Synthesis Methods*, n/a(n/a). <https://doi.org/10.1002/jrsm.1411>
- Miller, W. R., & Rollnick, S. (2014). The effectiveness and ineffectiveness of complex behavioral interventions: Impact of treatment fidelity. *Contemporary Clinical Trials*, 37(2), 234–241. <https://doi.org/10.1016/j.cct.2014.01.005>
- Murphy, J., & Dennhardt, A. A. (2016). The behavioral economics of young adult substance abuse. *Preventive Medicine*, 92, 24–30. <https://doi.org/10.1016/j.ypmed.2016.04.022>
- Murphy, J., Dennhardt, A. A., Skidmore, J. R., Borsari, B., Barnett, N. P., Colby, S. M., & Martens, M. P. (2012). A Randomized Controlled Trial of a Behavioral Economic Supplement to Brief Motivational Interventions for College Drinking. *Journal of Consulting and Clinical Psychology*, 80(5), 876–886. <https://doi.org/10.1037/a0028763>
- Patton, R., Deluca, P., Kaner, E., Newbury-Birch, D., Phillips, T., & Drummond, C. (2014). Alcohol screening and brief intervention for adolescents: The how, what and where of reducing alcohol consumption and related harm among young people. *Alcohol and Alcoholism*, 49(2), 207–212. <https://doi.org/10.1093/alcalc/agt165>
- Pocuca, N., London-Nadeau, K., Geoffroy, M. C., Chadi, N., Séguin, J. R., Parent, S., Boivin, M., Tremblay, R. E., Côté, S. M., & Castellanos-Ryan, N. (2022). Changes in Emerging Adults' Alcohol and Cannabis Use From Before to During the COVID-19 Pandemic: Evidence From a Prospective Birth Cohort. *Psychology of Addictive Behaviors*, 36(7), 786–797. <https://doi.org/10.1037/adb0000826>
- Signor, L., Pierozan, P. S., Ferigolo, M., Fernandes, S., Campos Moreira de, T., Mazoni, C. G., & Barros, H. M. T. (2013). Efficacy of the telephone-based Brief Motivational Intervention for alcohol problems in Brazil. *Revista Brasileira de Psiquiatria*, 35(3), 254–261. <https://doi.org/10.1590/1516-4446-2011-0724>
- Skidmore, J. R., Murphy, J. G., & Martens, M. P. (2014). Behavioral economic measures of alcohol reward value as problem severity indicators in

- college students. *Experimental and Clinical Psychopharmacology*, 22(3), 198–210. <https://doi.org/10.1037/a0036490>
- Smedslund, G., Berg, R. C., Hammerstrøm, K. T., Steiro, A., Leiknes, K. A., Dahl, H. M., & Karlsen, K. (2011). Motivational interviewing for substance abuse. *Cochrane Database of Systematic Reviews*, 2011(11). <https://doi.org/10.1002/14651858.cd008063.pub2>
- Steele, D. W., Becker, S. J., & Danko, K. J. (2020). Brief Behavioral Interventions for Substance Use in Adolescents: A Meta-analysis. *Pediatrics*, 46(4).
- Steinberg, L. (2018). Age of Opportunity: Lessons from the new science of adolescence. *Journal of Child and Adolescent Mental Health*, 30(1), 61–66.
- Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., Cates, C. J., Cheng, H.-Y., Corbett, M. S., Eldridge, S. M., Emberson, J. R., Hernán, M. A., Hopewell, S., Hróbjartsson, A., Junqueira, D. R., Jüni, P., Kirkham, J. J., Lasserson, T., Li, T., Higgins, J. P. T. (2019). RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ*. <https://doi.org/10.1136/bmj.l4898>
- Stockings, E., Hall, W. D., Lynskey, M., Morley, K. I., Reavley, N., Strang, J., Patton, G., & Degenhardt, L. (2016). Prevention, early intervention, harm reduction, and treatment of substance use in young people. *The Lancet Psychiatry*, 3(3), 280–296. [https://doi.org/10.1016/S2215-0366\(16\)00002-X](https://doi.org/10.1016/S2215-0366(16)00002-X)
- Tossmann, D. H.-P., Jonas, B., Tensil, M.-D., Lang, P., & Strüder, E. (2011). A Controlled Trial of an Internet-Based Intervention Program for Cannabis Users. *Cyberpsychology, Behavior, and Social Networking*, 14(11), 673–679. <https://doi.org/10.1089/cyber.2010.0506>
- UNODOC. (2021). *World Drug Report 2021*. World Drug Report 2021.
- Vasilaki, E. I., Hosier, S. G., & Cox, W. M. (2006). The Efficacy of Motivational Interviewing As A Brief Intervention For Excessive Drinking: A Meta-Analytic Review. *Alcohol and Alcoholism*, 41(3), 328–335. <https://doi.org/10.1093/alcalc/agl016>

Figure Captions:

Figure 1

Search process and Study Selection

Figure 2

Quality Assessment

Table 1.
Description and main features of the included randomized controlled trials

Study	Age range or mean, women	Follow-up (weeks)	Theoretical approach	Intervention	Length of intervention	Retention rates intervention and control (%)	
Mason & Zaharakis, 2018, (N=101)	18-24, n=41	12	MET	PNC-txt	4-weeks	95 both groups	
Buckner, Zvolensky & Lewis, 2020 (N=63)	18-30, n=53	2	MI and EDU	PFI-NAC	1 session	62 both groups	
Dennhardt, Yurasek, Murphy, 2015 (N=97)	18-22, n=57	16	MI and BE	BMI and SFAS	1 hour	88 and 67	
Fuster, Cheng, Wang, Bernstein, Palfai, Alford & Saitz, 2016 (N=167)	39.7, N=56	24	MI	BNI and MOTIV	1 hour	98 both groups	
Haller, Meynard, Lefebvre, Ukoumunne, Narring & Broers, 2014 (N= 594)	15-24, n=316	48	MI and BE	BMI	15 days	73 and 72	%
Lee, Neighbors, Kilmer & Larimer, 2010. (N=341)	17-19, n=186	24	MI	Web-PFI	1 session (Participants could rewatch the information for 3 months)	94 both groups	n=
McCambridge, Slym & Strang, 2008 (N=326)	16-19, n= 101	24	MI	MI	1 hour	80 and 82	n=
Signor, Pierozan, Ferigolo, Fernandes, Mazoni, & Barros, 2013 (N=637)	21-37, N=185	24	MI and BE	BMI	7 days (30 minutes sessions each day)	22 and 24	%
Tossmann, Jonas, Tensil, Lang & Strüber, 2011 (N=789)	24.7, N=	12	Self-regulation and self-control	QTS	50 days	28 and 25	n=
Stein, Hagerty, Herman, Phipps & Anderson, 2011 (N=332)	18-24, n=332	24	MI and BE	BMI	2 sessions	79 and 80	% 42

Effectiveness (Mean or % post-intervention) Treatment group vs control group	Control group (s)	Substances	Measures used for assessing substance use	Results
n=47; mean=20.2, SD=9.1 vs n=49; mean=20.6, SD=8.9	Assessment only	Cannabis	Urine drug test Youth Risk Behavior Survey CUDIT-R ASSIST	Significant p<0.05
Data not reported	Assessment only	Cannabis	Self-report version of the TLFB SIAS-S Brief Marijuana Consequences Questionnaire Daily drinking Questionnaire Rutgers Alcohol Problems Index	Significant p<0.05
n=44; mean=6.31, SD=3.3 vs n=33; mean=6.39, SD=4.2	Education sessions and BMI	Alcohol and Cannabis	Daily Drinking Questionnaire Young Adult Alcohol Consequences Questionnaire Marijuana Problems Scale Delay Discounting Task Adolescent Reinforcement Survey Schedule- Substance Use Version (ARSS-SUV) Alcohol Purchase Task (APT)	Significant p<0.05
n=59; mean=22.7, SD=9.7 vs n=53; mean=24.4, SD=8.5	List of substance use treatment resources	Cannabis	ASSIST TLFB 15-item short inventory of problems drugs (SIP-D) AUDIT-C	Not significant
% Events (substance use) = 33.2, n=287 vs % events=34.2, n=307	Assessment only	Alcohol and Cannabis	DEP-ADO clinical questionnaire	Not significant
n=171; mean=11.0, SD=18.7 vs n=170; mean=11.9, SD=19.3	Assessment only	Cannabis	Global Appraisal of Individual Needs-I Rutgers Marijuana Problem Index RTCQ BDP	Not significant
n=164; mean=13.8, SD=11.9 vs n=162; mean=14.5, SD=11.8	Drug information and advice-giving.	Cannabis	The Severity of Dependence Scale AUDIT	Not Significant
% Events (substance use) = 84.3, n=293 vs % events=90.1, n=344	Assessment and self- help material	Alcohol	NHSDA SAMHSA	Significant but with low retention rates p<0.05
n=863; mean=16.5, SD=20.5 vs n=429; mean=21, SD=17.1	Waiting list	Cannabis	Information on the frequency (days of consumption) and the quantity (in grams) German adaptation of the Drug-Taking Confidence Questionnaire-8.	Significant but with low retention rates p<0.05
% Events (substance use reduction) = 42.3, n=163 vs % events=36.0, n=169	Assessment only	Cannabis	TLFB Marijuana Problem Scale Structured Clinical Interview for DSM-IV Axis I Disorders SCID-I	Not Significant

Laporte, Vaillant-Roussel, Pereira, Blanc, Eschaliér, Kinouani & Vorilhon, 2017 (N=261)	15-25, n=93	48	MI	FRAMES	1 session	51 and 61	n=1
---	-------------	----	----	--------	-----------	-----------	-----

Note: MET: Motivational Enhancement Therapy; EDU: Educational control; PNC-txt: Peer Network Counseling-txt; PFI-NAC: personalized feedback intervention and strategies to manage negative affect; PFI: Personalized Feedback Intervention; NAC: Negative Affect and Cannabis; TLFB: timeline Follow-back; MI: Motivational Intervention; BE: behavioral economics; BMI: Brief Motivational Interview; SFAS: substance-free activities sessions associated with delayed rewards; BNI: Brief Negotiated Interview; MOTIV: Adaptation of Motivational Interviewing; FRAMES: Feedback, responsibility, Advice, menu, empathy, self-efficacy; WEB-PFI: web personalized feedback intervention; AUDIT-C: Alcohol Use Disorders Identification Test. DEP-ADO: screening instrument; PFI: Personalized Feedback Intervention; RTCQ: Readiness to Change Questionnaire; BDP: Brief Drinker Profile; NHSDA: Household Survey on Drug Abuse; SAMHSA: The Substance Abuse and Mental Health; QTS: Quit The Shit

Table 2.
Overview of interventions examined in included studies

Study	Payment	Study objective	
Mason & Zaharakis, 2018, (N=101)	Yes, for assessment only (up to \$150 in gift cards)	Cannabis use reduction	
Buckner, Zvolensky & Lewis, 2020 (N=63)	Yes, research credit for participating in psychology courses for completion of each survey	Cannabis use reduction	
Dennhardt, Yurasek, Murphy, 2015 (N=97)	Not reported	Alcohol and cannabis use reduction Reduce value of substance use	
Fuster, Cheng, Wang, Bernstein, Palfai, Alford & Saitz, 2016 (N=167)	Not reported	Cannabis use reduction	Ba 12
Haller, Meynard, Lefebvre, Ukoumunne, Narring & Broers, 2014 (N= 594)	Not reported	Reducing binge drinking and excessive cannabis use	
Lee, Neighbors, Kilmer & Larimer, 2010. (N=341)	Yes, \$10 for completing screening, \$25 for baseline, and \$30 for 3- and 6-month follow-ups	Prevent marijuana use and reduced it	
Slym & Strang, 2008 (N=326)	Yes, £10 per episode of data collection	Cannabis use reduction	
Signor, Pierozan, Ferigolo, Fernandes, Mazoni, & Barros, 2013 (N=637)	Not reported	Alcohol use reduction	

n=141; mean=17.5, SD=14.5 vs n=121; mean=17.5, SD=9.0	Usual intervention	Cannabis	Number of joints and bongs smoked, the quantity of alcohol and cigarettes consumed, and experimentation with other drugs. Cannabis Abuse Screening Trial (CAST)	Not significant
Type of professional	Delivery type	Primary outcome	Type of measure (urine analysis or self-report)	
Not reported	Online (Text messages)	Past-30-day cannabis use	Urine sample and self-report	
Not reported	Online	Cannabis use frequency	Self-report	
Clinician	In person	Delay discounting and alcohol and cannabis reward value	Self-report	
Bachelor's degree level health educators trained for 120 hours initially and received 1-2 booster sessions per year	In person	Number of days of marijuana use during the past 30 days	Self-report	
Family physicians	In person	Past 30 days excessive alcohol or cannabis use	Self-report	
Not reported	Online	Past 90 days Marijuana use	Self-report	
Psychology graduates trained in MI skills	In person	Past 3 months cannabis use frequency	Self-report and saliva sample but it wasn't analyzed	
Trained counselors	By phone call	complete avoidance of any alcohol consumption	Self-report	

Tossmann, Jonas, Tensil, Lang & Strüber, 2011 (N=789)	Yes, shopping voucher worth 30 Euro	Cannabis use reduction	
Stein, Hagerty, Herman, Phipps & Anderson, 2011 (N=332)	Yes, \$30 for the baseline, \$20 for the 1-month, \$40 for the 3-month, and \$50 for the 6-month assessments	Marijuana use reduction	
Laporte, Vaillant-Roussel, Pereira, Blanc, Eschaliér, Kinouani & Vorilhon, 2017 (N=261)	Yes, general practitioners were paid €80 per patient enrolled; patients were not paid	Cannabis use reduction	Ge

Trained therapist	Online	Past 30 days cannabis use frequency and quantity	Self-report
Clinical psychologists trained in MI skills	In person	Past 30 days marijuana use since last interview (30 days)	Self-report
General practitioners in primary care practices trained in BMI	In person	Number of joints smoked per month	Self-report

