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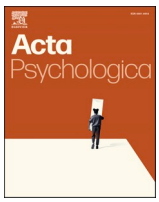

Effectiveness of the adolescent-community reinforcement approach for treating Cannabis use disorder in Iranian adolescents: A randomized controlled trial

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ABSTRACT

The Adolescent Community Reinforcement Approach (A-CRA) is an evidence-based intervention for adolescents with cannabis use disorder (CUD). This study evaluated the effectiveness of A-CRA among Iranian adolescents with CUD. A total of 40 male adolescents aged 15 to 18 (Mean = 15.87, *SD* = 1.02), diagnosed with CUD, were recruited from child labor welfare educational centers in Tehran through purposive sampling. Participants were randomly assigned to the A-CRA group ($n = 20$) or Treatment as Usual (TAU) group ($n = 20$). Assessments were conducted pre-test, post-intervention, and at a three-month follow-up. The results revealed that A-CRA was associated with higher rates of abstinence, reduced frequency of cannabis use, decreased substance-related problems, and lower levels of psychological distress. Additionally, adolescents in the A-CRA group demonstrated improvements in health-promoting lifestyles and more positive mother-adolescent relationships. These findings support the efficacy of A-CRA in addressing multiple dimensions of CUD in Iranian adolescents.

1. Introduction

Cannabis use disorder (CUD) is a problematic pattern of cannabis consumption that leads to clinically significant impairment or distress, occurring within a 12-month period (American Psychiatric Association, 2013). Cannabis is the most commonly used psychoactive substance among adolescents (United States Department of Health and Human Services., 2013), and its prevalence increases from 8th to 12th grade in the United States (Kroutil et al., 2010; Miech et al., 2023). A study in the United States showed that cannabis is the primary substance found after the arrest of adolescents. It is also the main substance that adolescents admit to using during psychotherapy (Dennis et al., 2002).

Numerous studies have shown that daily or regular cannabis use (defined as usage 10 times or more per month) can significantly impair cognitive abilities and motivation in adolescents, leading to declines in academic performance, social judgment, emotional responsiveness, and executive functioning (Aharonovich et al., 2008; Crean et al., 2011; Solowij et al., 2002). Prolonged misuse of cannabis can also induce neurophysiological changes, increasing susceptibility to psychiatric disorders (Rey et al., 2004). For instance, the risk of developing psychotic disorders escalates with greater frequency of use, higher potency of cannabis products, and earlier age of onset (Sundram, 2006). Additionally, marijuana misuse has been correlated with reductions in IQ scores and academic achievement (McCance-Katz, 2019). Given the psychological, social, and medical consequences of cannabis use among adolescents, there is growing interest in developing effective outpatient treatments for adolescents with cannabis use disorders and related issues.

In this regard, a meta-analysis showed that brief intervention sessions and individual or group cognitive-behavioral therapy (CBT) have a positive impact on reducing cannabis dependence and related problems, though CBT was found to yield better outcomes compared to brief interventions (Denis et al., 2006). Additionally, incorporating token-based incentives, and combining them with other effective therapeutic interventions can enhance treatment efficacy (Denis et al., 2006). In the meantime, a recent meta-analysis examined the effects of brief

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behavioral interventions for adolescents (ages 12–20) with problematic substance use, including motivational interviewing (MI), psychoeducation, and standard treatment. Findings indicated that MI effectively reduced heavy alcohol use, alcohol use days, and substance-related problems among adolescents, though it did not significantly reduce cannabis use days (Steele et al., 2020).

Meanwhile, it is important to note that existing treatments for CUD in adolescents have often overlooked the importance of family dynamics and family support as crucial components of treatment during this developmental stage (Bukstein et al., 2005; Thatcher and D. B. C, 2006). Multisystemic approaches emphasize the need to address risk factors not only within the family but also within the school, peer groups, and community systems during adolescence (Bender et al., 2011). In this vein, the research emphasizes the Adolescent-Community Reinforcement Approach (A-CRA) as a particularly effective behavioral intervention for treating CUD (Godley, 2001). This therapeutic program, based on the Community Reinforcement Approach (CRA), draws from learning theories, particularly operant conditioning (Hunt & Azrin, 1973). A-CRA emphasizes the interaction between individual behavior and the environment in addressing substance and alcohol dependence. The approach is centered around the idea that the environment or community can significantly influence an individual's substance use by reinforcing positive alternative behaviors. The concept of "community" is broad, encompassing various "reinforcers" such as family, friends, employment, hobbies, and recreational activities. The primary objective of A-CRA is to enhance the individual's environment to make engagement in alternative activities more rewarding than substance use (Godley, 2001). A-CRA consists of nineteen procedures, including problem-solving, communication, anger management, and relapse prevention skills. Another unique component is medication monitoring and adherence, which helps ensure compliance with prescribed medications (Godley, 2001). Clinicians select from a menu of procedures to tailor the treatment to each adolescent's specific needs. Additionally, there are sessions designed for parents or caregivers, as well as joint family sessions for both the adolescent and the parent or caregiver. The A-CRA procedures have been adapted multiple times to ensure they are developmentally appropriate for adolescents (Godley, 2001).

The A-CRA was evaluated and compared with four other common treatments in the Cannabis Youth Treatment (CYT; Dennis et al., 2004) project which is one of the largest controlled studies on outpatient treatment for adolescents with CUD. The treatments compared included five sessions of Motivational Enhancement Therapy (MET) combined with CBT, a 12-session MET/CBT program, the Family Support Network (FSN), and Multidimensional Family Therapy (MFT) over a period of 12 months. Findings indicated that while all these treatments were effective in reducing cannabis use and other issues, the A-CRA stood out as the most cost-effective option. Another significant advantage of A-CRA is its flexibility; the sessions designed for adolescents and their families, as well as the scheduling of A-CRA procedures, can be easily adapted into clinical practice (Dennis et al., 2004). There is substantial evidence supporting A-CRA's effectiveness in reducing alcohol and other substance use problems among adolescents (Godley et al., 2017; Godley et al., 2009; Henderson et al., 2016). Moreover, evidence suggests that A-CRA helps decrease substance-related problems and improves mental health indicators, such as abstinence rates, across various populations (Godley et al., 2011), homeless adolescents (Slesnick et al., 2007), and adolescents with co-occurring psychiatric and substance use disorders (Godley et al., 2014).

The effectiveness of the A-CRA has been well-documented in Western contexts, particularly in the United States. However, there is a growing recognition of the need to evaluate and potentially adapt this approach for use in Eastern cultures, such as Iran. This examination is crucial for several reasons. Firstly, the cultural, social, and legal contexts surrounding substance use in Iran differ significantly from those in Western countries (e.g., Ebrahimi et al., 2021; Elhami Athar, 2023; Elhami Athar et al., 2023; Elhami Athar et al., 2024; Elhami Athar & Azamian Jazi, 2022). For instance, cannabis use is strictly prohibited in Iran, which may affect usage patterns and the stigma associated with seeking treatment (Rostam-Abadi et al., 2021). Additionally, a systematic review examining the prevalence and trends of cannabis use in Iran found that, although cannabis use is less prevalent compared to many countries, both cannabis use and CUD are on the rise in Iran (Rostam-Abadi et al., 2021). This trend indicates an emerging public health issue that necessitates effective intervention strategies. Additionally, while existing evidence supports the effectiveness of A-CRA in increasing abstinence rates and reducing substance use problems, other important variables that A-CRA is expected to influence—such as the adolescent-parent relationship and the promotion of a healthy lifestyle—have not been thoroughly evaluated in previous studies. A-CRA developers have posited that the approach's overarching philosophy is to utilize societal reinforcement of non-substance-related behaviors to establish a healthy lifestyle (Godley et al., 2009). Therefore, this study was conducted to address these gaps in the literature by examining the effectiveness of A-CRA in treating adolescents with CUD in Iran.

2. Method

2.1. Participants and procedure

A total of 40 male adolescents aged 15 to 18 (Mean = 15.87, SD = 1.02), diagnosed with cannabis use disorder (CUD), were recruited from child labor welfare educational centers in Tehran using a purposive sampling method. These adolescents attended educational centers and used services provided by the association but resided with their families, not in the centers. Using G-Power software with parameters set at α = 0.05, β = 0.95, and an effect size of 0.68 based on the study by Henderson et al. (2016), it was determined that a minimum of 30 participants was required to detect statistically significant differences. However, considering a potential 30 % dropout rate, the final sample size was adjusted to 20 participants per group. Inclusion criteria required participants to have a CUD diagnosis according to the *DSM-5* criteria and be between 15 and 18 years old. Exclusion criteria included the presence of psychotic symptoms, autism spectrum disorder, bipolar disorder or related conditions, all of which were assessed using the Structured Clinical Interview for *DSM-5* (SCID-5). Other exclusion criteria were intellectual disability (assessed using the Raven's Progressive Matrices test) and the use of stimulants or opioids, as self-reported by the adolescents. Additionally, following A-CRA guidelines participants were excluded if they missed more than three treatment sessions or completed fewer than ten A-CRA procedures.

After obtaining informed consent from both the adolescents and their parents, the first author conducted interviews with the participants to assess their eligibility based on the inclusion and exclusion criteria. Then, they were randomly assigned to either the A-CRA group (n = 20) or a Treatment as Usual (TAU) group (n = 20). The A-CRA intervention included 12 one-hour individual sessions with the adolescent, two sessions for parents (with only mothers participating in this study), and two joint sessions involving both the parent and adolescent. The A-CRA program includes 19 procedures, from which the therapist selects the most appropriate based on the individual needs of the participants during the intervention. Intervention procedures and case management activities for adolescents included functional analysis of substance use and social behaviors, self-assessment of happiness, goal setting for counseling, planning for acceptable social recreational activities, relapse prevention skills, communication skills, problem-solving skills, family relationship skills (such as problem-solving, communication, and enjoyable interactions), job-seeking skills, case management, anger management, crisis management, systematic encouragement, and urine testing. For parents, the procedures included caregiver communication skills and parent-adolescent communication skills (The content of the sessions with a brief description is provided in Table 1).

The control group received the TAU which included seven one-hour

Table 1
Timeline of A-CRA treatment sessions: treatment procedures and participants behavior therapy sessions.

Procedure	Time period	Covered procedures	Participant
1	Week 1 to 4	Functional Analysis of Substance Use	Adolescent
	Continuing	Strengthening the Therapeutic Relationship	Caregiver and Adolescent
2	Week 2 to 4	Functional Analysis of Social Behavior	Adolescent
3[a]	Week 1 to 4	Primary Happiness Scale Primary Counseling Goals	Adolescent
	Every session	Subsequent Happiness Scales Secondary Counseling Goals	Adolescent
4[a]	Every session, but should start in Weeks 1 to 4	Encouraging Social Behavior	Adolescent
5[a]	Every session	Relapse Prevention	Adolescent
6[a]	Every session	Communication Skills	Adolescent
7[a]	Every session	Problem-Solving Skills	Adolescent
8	Weeks 5 to 10	Urine Testing	Adolescent
9	Week 1	Introducing A-CRA to the Caregiver and Motivating Them	Caregiver
10	Weeks 3 to 5	Caregiver Communication Skills Training and Review	Caregiver
11	Weeks 5 to 11	Caregiver-Adolescent Communication Skills	Caregiver and Adolescent
12	Week 12	Review of Treatment Goals and Termination of Treatment	Adolescent
Optional[a]	If needed	Addressing Adolescent or Caregiver Absence Job Finding Anger Management Sobriety Sampling Systematic Encouragement Medication Adherence and Monitoring Couples Communication Skills	Caregiver or Adolescent Adolescent Adolescent Adolescent Adolescent Adolescent Caregiver

[a] The therapist can introduce these methods based on the situations presented during the therapy sessions.

psychoeducation on substance use, behavioral management techniques for managing cravings, and training in coping strategies (The content of the sessions with a brief description is provided in Table 2). Adolescents and their parents (mothers) were assessed before and after the intervention, and again three months post-intervention. Urine tests were also conducted to evaluate the adolescents' abstinence rates. Nine participants dropped out during the treatment phase (four from the intervention group and five from the TAU group). Consequently, the final analysis was conducted on 31 participants, comprising 16 in the intervention group and 15 in the control group. A graphical depiction of the recruitment process is presented in Fig. 1.

Of note, during the pre-test, post-test, and follow-up phases, all assessments were carried out by clinic and research staff who were blinded to the group assignments of the participants. This blinding procedure is crucial as it helps reduce bias and ensures that the assessments are

Table 2
Content of the treatment as usual therapy sessions.

Session	Content
First	Taking History and Motivational Enhancement and Goal Setting
Second	Dealing with Cannabis Triggers
Third	Coping with Cravings
Fourth	Refusal and Assertiveness Skills
Fifth	Problem-Solving Skills
Sixth	Coping with Anxiety and Stress
Seventh	Ending Treatment and Future Planning

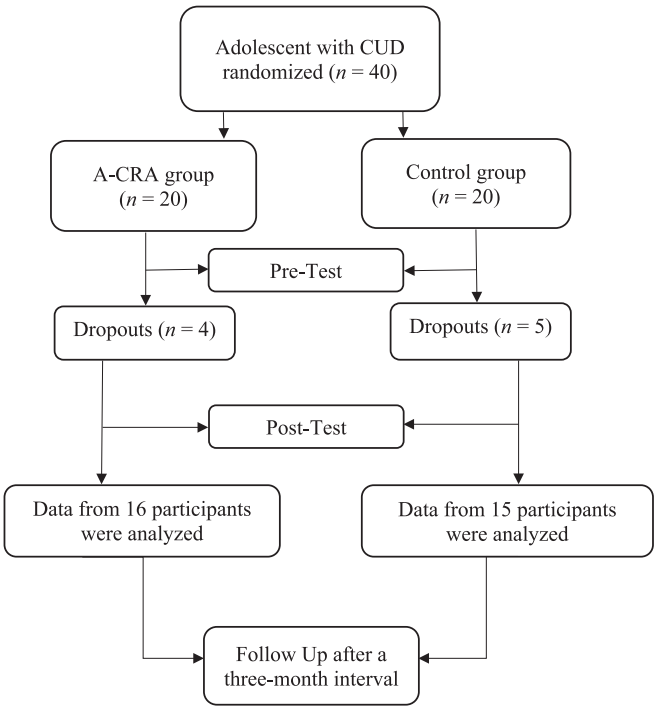

Fig. 1. Process chart from recruitment to follow-up measurement.

conducted objectively and impartially. This study was first reviewed and approved by the Research Deputy of Iran University of Medical Sciences (Code Number = IR.IUMS.REC.1401.621) and was registered in the Iranian Registry of Clinical Trials (ID Number = IRCT20230423057978N1, Registration Date: 2023-05-19).

2.2. Psychotherapists

A-CRA sessions were led by the first author who is a clinician with extensive CBT training and supervision, as well as specialized training in A-CRA. Similarly, the TAU sessions were led by a psychotherapist holding a Ph.D. in clinical psychology, who had also received thorough training and supervision in CBT. To maintain treatment fidelity and adherence to the protocol, all sessions for both groups were recorded with the participants' explicit consent. The supervisor, also trained in A-CRA, conducted random reviews of these recordings to ensure the quality and consistency of the therapeutic interventions.

2.3. Outcome measures

2.3.1. Urine cannabinoid test

The urine cannabinoid test is a high-quality, single-step, rapid assay designed for the qualitative detection of cannabinoids in urine samples. This test is calibrated to detect the presence of cannabis metabolites at a cutoff concentration of 50 ng/mL. The appearance of two pink/purple lines on the test strip indicates a negative result, suggesting that the concentration of tetrahydrocannabinol (THC) metabolites is below the detection threshold. Conversely, the presence of a single pink/purple line in the control region indicates a positive result, confirming that the THC metabolite concentration exceeds the specified cutoff level.

2.3.2. Substance Problems Scale (SPS)

The SPS is a subscale of the Global Appraisal of Individual Needs (GAIN) assessment tool, frequently used in research to evaluate treatment outcomes (Dennis et al., 2004; Godley et al., 2017). The SPS assesses 16 symptoms related to substance and alcohol use disorders, categorized based on recent usage ratings (e.g., past month, 2 to 12

months ago, >12 months ago, never). These symptoms include 7 criteria related to *DSM-IV* dependence, 4 related to abuse, 2 related to physical and mental health issues caused by substance and alcohol use, and 3 indicators of less severe use (such as covert use, complaints from others about the use, and weekly use). The SPS has demonstrated good test-retest reliability ($r = 0.70$; Denis et al., 2006).

2.3.3. The Depression Anxiety Stress Scale (DASS)

The DASS (Lovibond & Lovibond, 1995) is a self-report measure with 42 items designed to assess levels of depression, anxiety, and stress (14 items per subscale). Items are scored on a Likert-type scale ranging from 0 (*"did not apply to me at all"*) to 3 (*"applied to me very much"*). The scores for each subscale are calculated by summing the items corresponding to that subscale. The Persian version of the DASS-42 has demonstrated adequate psychometric properties, including validity and reliability (Afzali et al., 2007).

2.3.4. The Parent-Child Interaction Questionnaire (PACHIQ)

The PACHIQ (Lange et al., 1998) is a widely used tool among clinicians and researchers to assess the relationship between parents and their children from both perspectives. It consists of two versions: the PACHIQ-Parent Version, which contains 21 items focusing on how parents perceive their relationship with their children, and the PACHIQ-Child Version, comprising 25 items that assess how children view their relationship with their parents. Items explore various interpersonal behaviors, feelings, and perceptions, providing a comprehensive assessment of relational dynamics within the family unit. Across all informant versions, items are rated on a five-point Likert-type scale ranging from 1 (*"Never"*) to 5 (*"Always"*). The PACHIQ items load on two subscales of Conflict Resolution (i.e., the ability of parents and children to manage and resolve conflicts within their relationship) and Acceptance (i.e., the level of warmth, support, and acceptance within the parent-child relationship). A study in Iran demonstrated that the Persian version of the PACHIQ possesses adequate psychometric properties (Isanejad et al., 2017).

2.3.5. The Health-Promoting Lifestyle Profile (HPLP)

The HPLP (Walker et al., 1987) is a widely recognized instrument designed to evaluate health-promoting behaviors in individuals. The HPLP-II, the revised version of the original tool, consists of 52 items divided into six subscales: Health Responsibility, Physical Activity, Nutrition, Spiritual Growth, Interpersonal Relations, and Stress Management. Each item is rated on a 4-point Likert scale, ranging from 1 (*"never"*) to 4 (*"routinely"*). In this study, a 34-item version of the HPLP was utilized, focusing on four subscales: Stress Management, Nutrition, Physical Activity, and Health Responsibility. The Persian version of the HPLP demonstrated satisfactory psychometric properties (Mohamadian et al., 2013).

2.4. Data analyses

Data entry and statistical analyses were performed using SPSS version 21. To assess the normality of the distribution for outcome measures, we employed the Kolmogorov-Smirnov test, which confirmed that the data were normally distributed ($p > .05$). Differences in demographic and baseline outcome variables between groups were evaluated using independent *t*-tests for continuous variables and chi-squared tests for categorical variables. Chi-squared tests were used to compare the groups on nominal outcome measures while using Cramer's *V* coefficient as the measure of effect sizes interpreted as negligible (≤ 0.00), weak (≤ 0.10), moderate (≤ 0.20), relatively strong (≤ 0.40), strong (≤ 0.60), and very strong (≤ 0.80). Outcome measures were analyzed using repeated measures ANOVAs, with the condition (A-CRA vs. TAU) as the between-group factor and time (pre-test, post-test, and follow-up) as the within-group factor. Effect sizes were calculated using partial eta squared (η_p^2), where $\eta_p^2 = 0.01$ indicates a small effect size, 0.06 represents a medium effect size, and 0.14 denotes a large effect size (Tabachnick et al., 2013). Sphericity was tested using epsilon (ε) values; if the ε value was outside the acceptable range (i.e., $\varepsilon < 0.75$), the Greenhouse–Geisser correction was applied (Girden, 1992).

3. Results

3.1. Baseline differences

The demographic characteristics of the groups are displayed in Table 3, which indicates no significant differences between the groups ($p > .05$). Table 4 presents the descriptive statistics for the outcome variables across all assessment points for each group. At baseline, there were no significant differences in the outcome variables between the groups ($p > .05$).

3.2. Intervention effects

3.2.1. Urine cannabinoid test

Chi-square tests of independence were conducted to examine whether the distribution of positive and negative urine cannabinoid test results differed significantly between groups at the post-test and follow-up assessments. As shown in Table 5, at the post-test assessment, 2 participants in the A-CRA group tested positive for cannabinoids while 14 tested negative. In contrast, the control group had 9 participants testing positive and 6 testing negative. The chi-square test revealed a significant difference in the distribution of test results between the groups [χ^2 (1, $n = 31$) = 7. 63, $p =$. 006, $V =$. 50], indicating that the A-CRA intervention was more effective in reducing positive cannabinoid test results compared to the control condition. At the follow-up assessment, 5 participants in the A-CRA group tested positive and 11 tested

Table 3
Demographic characteristics by group.

Variables	Group			
	A-CRA (n = 16)	Control (n = 15)	t/χ^2	p
Age, Mean (*SD*)	16.00 (1.09)	15.73 (0.96)	0.72	0.48
Intelligence Quotient, Mean (*SD*)	97.44 (13.80	92.20 (10.30)	1.19	0.24
Number of Family Members, Mean (*SD*)	5.12 (1.74)	15.06 (2.15)	0.83	0.93
Education, Mean (*SD*)	4.62 (2.21)	4.47 (2.67)	0.18	0.56
Age of Onset of Cannabis Use, Mean (*SD*)	13.75 (1.43)	14.06 (1.62)	−0.57	0.57
Job Status, *n* (%)				
Employed	15 (93.75)	15 (100)	0.97	0.32
Jobless	1 (6.25)	1 (0.00)		
Father Education, *n* (%)				
Illiterate	10 (62.5)	9 (60)	0.46	0.79
Elementary School	5 (31.25)	4 (26.67)		
Diploma	1 (6.25)	2 (13.33)		
Father Education, *n* (%)				
Illiterate	15 (93.75)	12 (80.00)	1.64	0.44
Elementary School	1 (6.25)	2 (13.33)		
Diploma	0 (0.00)	1 (6.67)		
Substance and Alcohol Abuse Among Family Members, *n* (%)				
Positive	12 (75.00)	12 (80.00)	0.11	0.74
Negative	4 (25.00)	3 (20.00)		
Alcohol Abuse, *n* (%)				
Positive	11 (68.75)	9 (60.00)	0.26	0.61
Negative	5 (31.25)	6 (40.00)		
Cigarette use, *n* (%)				
Positive	16 (100)	15 (100)	0.002	0.96
Negative	0 (0.00)	0 (0.00)		
T2D Duration (in Year), Mean (*SD*)	9.31 (6.93)	9.69 (7.43)	0.051	0.95

Note. *SD* = Standard Deviation; χ^2 = Chi-squared test.

Table 4
Descriptive statistics of outcome variables across pre-test, post-test, and follow-up assessments.

Variable	Group	Pre-test	Post-test	Follow up
		Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
Substance Problems Scale	A-CRA	44.93 (9.89)	32.44 (9.63)	28.31 (9.84)
	Control	44.53 (6.51)	38.60 (7.43)	40.07 (10.00)
DASS Anxiety	A-CRA	15.44 (9.37)	6.69 (5.46)	8.12 (3.73)
	Control	10.80 (5.25)	10.93 (4.62)	9.73 (4.58)
DASS Depression	A-CRA	19.50 (10.73)	9.38 (8.36)	17.38 (7.31)
	Control	19.20 (8.79)	16.07 (4.74)	22.40 (4.84)
DASS Stress	A-CRA	22.38 (9.88)	11.50 (7.48)	20.12 (9.40)
	Control	21.33 (7.07)	21.00 (7.34)	24.60 (4.01)
PACHIQ Child – Report on Mother	A-CRA	90.31 (18.70)	99.00 (15.11)	95.56 (15.48)
	Control	94.13 (8.72)	88.60 (11.47)	87.20 (11.85)
PACHIQ Child – Report on Father	A-CRA	90.81 (13.39)	93.81 (17.29)	94.69 (12.65)
	Control	89.40 (8.76)	86.20 (10.36)	91.07 (8.96)
PACHIQ Mother - Report on Child	A-CRA	68.25 (6.22)	99.00 (15.11)	78.25 (5.45)
	Control	72.60 (6.63)	88.60 (11.47)	71.00 (7.77)
Health-Promoting Lifestyle Profile	A-CRA	80.31 (13.46)	89.44 (12.37)	84.06 (16.47)
	Control	71.80 (7.02)	67.87 (8.85)	70.80 (5.41)

Note. *SD* = Standard Deviation; *DASS* = The Depression Anxiety Stress Scale; *PACHIQ* = The Parent-Child Interaction Questionnaire.

Table 5
Comparison of groups in urine cannabinoid test results across assessment steps.

Assessment step	Urine cannabinoid test results	Group				
		A-CRA (n = 16)	Control (n = 15)	χ^2	p	V
Pre-Test	Positive	15 (93.75)	14 (93.33)	0.002	0.96	0.008
	Negative	1 (6.25)	1 (6.67)			
Post-Test	Positive	2 (12.50)	9 (60.00)	7.63	0.006	0.50
	Negative	14 (87.50)	6 (40.00)			
Follow-Up	Positive	5 (31.25)	13 (86.67)	9.76	0.002	0.56
	Negative	11 (68.75)	2 (13.33)			

Note. *SD* = Standard Deviation; χ^2 = Chi-squared test; V = Cramer's V.

negative for cannabinoids. Conversely, the control group had 13 participants testing positive and 2 testing negative. The chi-square test revealed a significant difference in the distribution of test results between the groups [χ^2 (1, n = 31) = 9.76, p =. 002, V =. 56], further demonstrating the sustained effectiveness of the A-CRA intervention in reducing positive cannabinoid test results.

3.2.2. Alcohol and drug problem severity

The results of the repeated measure ANOVA for the SPS showed a significant main effect of time [F (2, 29) = 33.73, p = .001, η_p^2 = 0.54], indicating significant differences in SPS scores across assessment steps. Additionally, a significant between-subject effect of the group was found [F (1, 29) = 4.31, p = .04, η_p^2 = 0.13], indicating significant differences in overall changes in SPS scores among the groups. Furthermore, a significant time × group interaction was observed [F (2, 29) = 9.47, p = .001, η_p^2 = 0.25], suggesting that changes in the SPS scores varied significantly between the groups across assessment steps (Table 6). Post hoc paired samples *t*-tests were performed to compare groups across the three assessment steps. As shown in Table 7, results indicated significant decreases in SPS scores in both groups from pre-test to post-test (ps < 0.001; ds = 1.39 and 1.45 for the A-ACR and TAU groups, respectively) but not from the post-test to follow-up (ps > 0.05). Both groups experienced significant decreases in SPS scores from pre-test to follow-up, though the magnitude of the changes was significantly stronger in the A-ACR group (p < .001; d = 1.77).

Table 6
The results of repeated measures ANOVAs.

Dependent variable	Source	F	p	η_p^2
Substance Problems Scale	Time	33.73	< 0.001	0.54
	Group	4.31	0.04	0.13
	Time × Group	9.47	< 0.001	0.25
DAS Anxiety	Time	8.49	< 0.001	0.23
	Group	0.07	0.80	0.00
	Time × Group	7.33	< 0.001	0.20
DAS Depression	Time	13.09	< 0.001	0.31
	Group	3.13	0.09	0.10
	Time × Group	2.74	0.07	0.09
DAS Stress	Time	9.64	< 0.001	0.25
	Group	3.96	0.06	0.12
	Time × Group	5.82	0.004	0.17
PACHIQ Child – Report on Mother	Time	0.56	0.53	0.02
	Group	1.36	0.25	0.04
	Time × Group	5.49	0.01	0.16
PACHIQ Child – Report on Father	Time	1.38	0.26	0.05
	Group	1.22	0.28	0.04
	Time × Group	1.29	0.28	0.04
PACHIQ Mother - Report on Child	Time	89.04	< 0.001	0.75
	Group	2.86	0.10	0.09
	Time × Group	8.65	< 0.001	0.23
Health-Promoting Lifestyle Profile	Time	1.12	0.33	0.04
	Group	16.41	< 0.001	0.36
	Time × Group	7.24	< 0.001	0.20

Note. η_p^2 = Partial Eta Squared; *DASS* = The Depression Anxiety Stress Scale; *PACHIQ* = The Parent-Child Interaction Questionnaire.

3.2.3. Depression, anxiety, and stress scores

The repeated measure ANOVA showed a significant main effect of time [F (2, 29) = 8.49, p < .001, η_p^2 = 0.23] and a significant time × group interaction [F (2, 29) = 7.33, p < .001, η_p^2 = 0.20] on DASS anxiety scores. As represented in Table 6, post hoc paired samples *t*-tests showed significant declines in anxiety scores only for the A-CRA group from pre-test to post-test (p < .001; d = 1.38) and pre-test to follow-up (p = .002; d = 0.91).

In terms of DASS depression scores, only a significant main effect of time [F (2, 29) = 13.09, p < .001, η_p^2 = 0.31] was observed. Table 7 shows that depression scores decreased significantly from the pre-test to the post-test (p < .001; ds = 1.24) only in the A-ACR group. Nevertheless, both groups experienced significant increases in depression scores from the post-test to the follow-up the magnitude of which was stronger for the TAU group (d = −1.08; Table 5).

Concerning DASS stress scores, Table 6 shows that the repeated measure ANOVA revealed a significant main effect of time [F (2, 29) = 9.64, $p \leq$ 0.001, η_p^2 = 0.25] and a significant time × group interaction [F (2, 29) = 5.82, p = .004, η_p^2 = 0.17]. As represented in Table 7, post hoc paired samples *t*-tests showed significant declines in stress scores only for the A-CRA group from pre-test to post-test (p < .001; d = 1.20), though treatment gains in stress scores decreased significantly from post-test to follow-up (p = .006; d = −0.80).

3.2.4. Parent-child interactions

The repeated measure ANOVA showed only a significant effect of time × group interaction [F (2, 29) = 5.49, p = .01, η_p^2 = 0.16] on PACHIQ child report on mother subscale scores. Also, significant main effects of time [F (2, 29) = 89.04, p < .001, η_p^2 = 0.75] and time × group interaction [F (2, 29) = 8.65, p < .001, η_p^2 = 0.23] was observed for the PACHIQ mother - report on child subscale scores (Table 6). As represented in Table 7, post hoc paired samples *t*-tests showed a significant increase in PACHIQ child report on mother scores only for the A-CRA group from pre-test to post-test (p < .006; d = 0.78), though significant decreases were observed for the TAU group from pre-test to post-test and pre-test to follow-up (ps = 0.003 and 0.02; d = −0.71 and −0.90, respectively). Regarding the PACHIQ mother-report on child subscale, findings indicated significant increases from pre-test to post-test for both groups though with a stronger effect size for the A-CRA group (p < .001;

Table 7
Paired samples t-tests to make post hoc comparisons between groups across assessment steps.

Dependent variable	Group	Time (I)	Time (J)	Mean difference (I-J)	*SD*	*t*	*p*	*d*
Substance Problems Scale	A-CRA	Pre-Test	Post-Test	12.50	8.98	5.57	< 0.001	1.39
		Post-Test	Follow Up	4.13	8.91	1.85	0.08	0.46
		Pre-Test	Follow Up	16.63	9.41	7.07	< 0.001	1.77
	Control	Pre-Test	Post-Test	5.93	4.10	5.61	< 0.001	1.45
		Post-Test	Follow Up	−1.47	6.74	−0.84	0.41	−0.22
		Pre-Test	Follow Up	4.47	6.93	2.50	0.03	0.64
DASS Anxiety	A-CRA	Pre-Test	Post-Test	8.75	8.09	4.33	< 0.001	1.08
		Post-Test	Follow Up	−1.44	5.48	−1.05	0.31	−0.26
		Pre-Test	Follow Up	7.31	8.04	3.64	0.002	0.91
	Control	Pre-Test	Post-Test	−0.13	6.03	−0.09	0.93	−0.02
		Post-Test	Follow Up	1.20	5.86	0.79	0.44	0.20
		Pre-Test	Follow Up	1.07	5.56	0.74	0.47	0.19
DASS Depression	A-CRA	Pre-Test	Post-Test	10.13	8.15	4.97	< 0.001	1.24
		Post-Test	Follow Up	−8.00	9.00	−3.55	0.002	−0.30
		Pre-Test	Follow Up	2.13	12.47	0.68	0.51	0.66
	Control	Pre-Test	Post-Test	3.13	7.76	1.56	0.14	0.40
		Post-Test	Follow Up	−6.33	5.84	−4.20	< 0.001	−1.08
		Pre-Test	Follow Up	−3.20	7.04	−1.76	0.10	−0.45
DASS Stress	A-CRA	Pre-Test	Post-Test	10.88	9.05	4.80	< 0.001	1.20
		Post-Test	Follow Up	−8.62	10.76	−3.21	0.006	−0.80
		Pre-Test	Follow Up	2.25	9.57	0.94	0.36	0.23
	Control	Pre-Test	Post-Test	0.33	6.50	0.20	0.85	0.05
		Post-Test	Follow Up	−3.60	7.75	−1.80	0.09	−0.46
		Pre-Test	Follow Up	−3.27	6.85	−1.85	0.09	−0.48
PACHIQ Child – Report on Mother	A-CRA	Pre-Test	Post-Test	8.69	11.09	3.13	0.006	0.78
		Post-Test	Follow Up	−3.44	13.87	−0.99	0.34	−0.24
		Pre-Test	Follow Up	5.25	19.86	1.06	0.31	0.26
	Control	Pre-Test	Post-Test	−5.53	6.13	−3.50	0.003	−0.90
		Post-Test	Follow Up	−1.40	12.00	−0.45	0.66	−0.12
		Pre-Test	Follow Up	−6.93	9.74	−2.76	0.02	−0.71
PACHIQ Mother - Report on Child	A-CRA	Pre-Test	Post-Test	30.75	14.18	8.68	< 0.001	2.17
		Post-Test	Follow Up	−20.75	13.98	−5.94	< 0.001	−1.48
		Pre-Test	Follow Up	10.00	5.29	7.56	< 0.001	1.89
	Control	Pre-Test	Post-Test	16.00	10.30	6.01	< 0.001	1.55
		Post-Test	Follow Up	−17.60	8.68	−7.86	< 0.001	−2.02
		Pre-Test	Follow Up	−1.60	5.93	−1.05	0.31	−0.27
Health-Promoting Lifestyle Profile	A-CRA	Pre-Test	Post-Test	9.12	10.86	3.36	0.004	0.84
		Post-Test	Follow Up	−5.38	9.47	−2.27	0.04	−0.57
		Pre-Test	Follow Up	3.75	12.46	1.20	0.25	0.30
	Control	Pre-Test	Post-Test	−3.93	9.10	−1.67	0.12	−0.43
		Post-Test	Follow Up	2.93	8.12	1.40	0.18	0.36
		Pre-Test	Follow Up	−1.00	6.58	−0.59	0.57	−0.15

Note. *SD* = Standard Deviation; *DASS* = The Depression Anxiety Stress Scale; *PACHIQ* = The Parent-Child Interaction Questionnaire; *A-CRA* = Adolescent-Community Reinforcement Approach; *d* = Cohen's *d*.

$d = 2.17$). Both groups experienced decreases in the PACHIQ mother-report on child subscale from post-test to follow-up with a stronger effect size for the TAU group ($p < .001$; $d = -2.02$). Nevertheless, only the A-CRA group demonstrated significant improvements from the pre-test to the follow-up ($p < .001$; $d = 1.89$).

3.2.5. *Health-promoting lifestyle*

A repeated measure ANOVA yielded significant effects of the group [$F(2, 29) = 16.41$, $p < .001$, $\eta_p^2 = 0.36$] and time × group interaction [$F(2, 29) = 7.24$, $p < .001$, $\eta_p^2 = 0.20$] on health-promoting lifestyle profile scores (Table 6). Regarding post hoc tests presented in Table 7, paired samples *t*-tests showed significant improvement only for the A-CRA group from pre-test to post-test ($p < .004$; $d = 0.84$).

4. Discussion

This study examined and compared the effectiveness of A-CRA in treating CUD among Iranian adolescents. The findings indicated that A-CRA is effective in increasing abstinence rates, reducing substance use frequency and related problems, decreasing psychological issues, improving health-promoting lifestyle behaviors, and enhancing mother-child interaction. Moreover, A-CRA demonstrated superiority over the TAU approach. We discuss the findings in further detail below.

The findings indicate that the A-CRA intervention was significantly more effective in reducing positive cannabinoid test results compared to the TAU group. Notably, only a few individuals in the A-CRA group tested positive at both the post-test and follow-up assessments, in contrast to the higher rates observed in the TAU group. Additionally, A-CRA demonstrated superior effectiveness in reducing substance-related problems (SPS) compared to TAU. The success of A-CRA in increasing abstinence rates, as measured by urine tests, and in mitigating substance use problems is consistent with previous research (Godley, 2001; Godley et al., 2011; Godley et al., 2014; Godley et al., 2017; Godley et al., 2009; Henderson et al., 2016; Slesnick et al., 2007). This effectiveness can be attributed to the functional analysis component of A-CRA, which assists adolescents in identifying and altering the circumstances that promote substance use. This process involves recognizing the antecedents of substance use, as well as understanding the positive and negative consequences associated with it. Moreover, the functional analysis of social activities within A-CRA helps adolescents identify and increase engagement in positive social activities that they currently enjoy or are likely to enjoy in the future. These two mechanisms work synergistically to reduce substance use, as A-CRA's underlying theories suggest that the treatment helps adolescents gradually perceive a substance-free lifestyle as more rewarding than substance use, ultimately leading to a decrease in substance use behaviors (Godley, 2001).

In addition, the results showed that A-CRA was effective in reducing anxiety, depression, and stress in adolescents which is consistent with

findings of prior studies. For instance, studies by Godley and colleagues (Godley et al., 2014; Godley et al., 2017) demonstrated that A-CRA interventions led to a decrease in the average number of days adolescents experienced emotional difficulties and reductions in internalizing and externalizing problems. A meta-analysis by Skeen et al. (2019) on effective components of mental health interventions for adolescents highlighted that communication skills, emotion regulation, substance and alcohol education, mindfulness, problem-solving, assertiveness training, and stress management were all associated with significant reductions in anxiety and depression and the prevention of substance use. Similarly, in A-CRA, adolescents are helped to manage problems that cause stress and anxiety by learning and practicing problem-solving, stress management, conflict resolution skills within the family, and case management.

Meanwhile, it is important to highlight that in the A-CRA group, treatment gains were maintained at follow-up only for anxiety scores. While this finding is noteworthy, identifying the specific reasons behind these differential outcomes remains tentative within the context of this study. Therefore, to better understand this phenomenon, we recommend that future studies focus on clarifying the mechanisms underlying these results, with particular emphasis on examining A-CRA's comparative effectiveness across anxiety, depression, and stress. In addition, findings suggest that future research might benefit from identifying, selecting, and incorporating A-CRA components that specifically target both stress and depression, thereby supporting sustained improvements across multiple psychological domains. Another effective strategy would be to implement an integrative approach that combines A-CRA with additional evidence-based interventions specifically targeting stress and depression, such as mindfulness practices and pharmacotherapy (e.g., Huang & Pan, 2023). This could enhance overall treatment outcomes by addressing the multifaceted nature of co-occurring mental health challenges in individuals with substance use disorders.

In this study, we also examined the interactions of parent-adolescent which showed significant improvements in the attitudes of both the child towards the mother and the mother towards the child within the A-CRA group compared to the TAU group. This aspect, while not previously evaluated in A-CRA studies, was assessed in this study as it could influence adolescents' substance and alcohol use. In this regard, researchers have consistently highlighted the importance of treating adolescent substance users within the family context (Thatcher & Clark, 2006). Studies have shown that involving the family in treatment, whether through individual or family therapy, correlates with higher abstinence rates and fewer substance use issues in adolescents (Bender et al., 2010; Dennis et al., 2004; Tripodi et al., 2010). A key goal of A-CRA is to strengthen family relationships, as trust issues between caregivers and adolescents are often worsened by substance use, and strained parent-adolescent relationships are linked to increased substance use. A-CRA aims to enhance family communication and create a more supportive home environment (Godley, 2001). In this study, only mothers participated in the treatment sessions, resulting in improvements exclusively in the mother-adolescent relationship, while the adolescent's attitude towards the father remained unchanged—an outcome expected given the fathers' non-participation. The sessions focused on motivating mothers to engage in the A-CRA process, promoting adolescent abstinence through changes in parental behavior, and teaching effective parenting strategies. Mothers were trained to model substance-free behavior, enhance communication with their adolescents, encourage social activities, and practice conflict resolution to create a more supportive family environment.

Finally, our findings revealed that the A-CRA group showed significant improvements in health-promoting lifestyles, a variable not directly assessed in previous research. In this regard, Godley et al. (2009) emphasize that A-CRA's core philosophy involves using community support to reinforce non-substance-related behaviors, thereby fostering a healthy lifestyle. The improvements in the health-oriented lifestyle can be attributed to several aspects of the A-CRA approach such as encouraging adolescents to take greater responsibility for their health, develop more effective stress management techniques, and integrate physical activities as rewarding and enjoyable elements of their daily lives.

5. Limitations and directions for future research

Our findings should be interpreted with consideration of several limitations. Firstly, the study's participants were adolescents from low socioeconomic backgrounds, many of whom were behind in their education and employed. This specific demographic suggests that caution is needed when generalizing the results to other populations. Secondly, the sample was limited to male adolescents with CUD due to constraints in participant availability, preventing us from including female adolescents. This limitation restricts the generalizability of our findings, and future research should strive to include both male and female adolescents to assess the broader applicability and any gender-specific effects of the A-CRA approach. Additionally, only mothers were included in treatment sessions as primary caregivers, as recruiting fathers proved challenging. This represents a notable limitation, especially given that over half of the participating families had fathers with substance or alcohol use issues. Future studies should aim to incorporate fathers in order to gain a more comprehensive understanding of family dynamics and their impact on treatment outcomes, potentially enhancing the effectiveness of A-CRA for families affected by substance use. Third, this study lacked comparison with other evidence-based interventions for CUD, limiting insight into A-CRA's unique advantages over alternative treatments. Future studies should incorporate such comparisons to more clearly establish A-CRA's distinct benefits. Fourth, future studies should incorporate longer-term follow-up periods to more accurately assess the durability of treatment effects and monitor potential relapse rates. This would provide valuable insights into the sustained impact of A-CRA on CUD outcomes and inform strategies for long-term recovery support. Finally, future studies should consider increasing the sample size to improve statistical power and enhance the generalizability of findings on A-CRA's effectiveness for CUD treatment outcomes.

6. Conclusion

This study demonstrated that the A-CRA significantly enhanced outcomes for adolescents struggling with CUD. Specifically, A-CRA was effective in increasing abstinence rates, reducing cannabis use frequency and other drug-related problems, alleviating psychological distress, promoting a healthier lifestyle, and improving mother-adolescent interactions. These findings underscore the efficacy of A-CRA's comprehensive approach, which integrates biological, psychological, and social dimensions, and leverages community resources to foster positive behavior change. Given its effectiveness, it is recommended that stakeholders allocate resources to train practitioners and implement A-CRA in settings where adolescents with substance use issues are identified.

Informed consent

Participants provided an informed consent form after being assured about the study aims and the confidentiality of the data.

Ethics approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was first reviewed and approved by the Research Deputy of Iran University of Medical Sciences (Code Number = IR.IUMS.REC.1401.621) and was registered in the Iranian Registry of Clinical Trials (ID Number = IRCT20230423057978N1, Registration Date: 2023-05-19).

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CRediT authorship contribution statement

Najmeh Khosrovan Mehr: Writing – review & editing, Writing – original draft, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Fahimeh Fathali Lavasani:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Alireza Noroozi:** Writing – review & editing, Writing – original draft, Conceptualization. **Hojjatollah Farahani:** Writing – review & editing, Writing – original draft, Conceptualization. **Banafsheh Gharraee:** Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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