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Comparison of Executive Functions and Resilience in Two Groups of Cannabis Users and Non-Users

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A B S T R A C T

The present study aims to compare executive functions and resilience between two groups of cannabis users and non-users. Given the prevalence of cannabis use among young people and its impact on various psychological and social aspects, examining these factors seems essential. This descriptive study is ex-post facto in nature. The statistical population included men and women over 18 years old, from which 60 individuals were selected through convenience sampling. To assess executive functions, the Heppner Problem Solving Inventory and the Carver and White Behavioral Inhibition-Activation Questionnaire were used, and for assessing resilience, the Connor-Davidson Resilience Scale was employed. Data were analyzed using Multivariate Analysis of Variance (MANOVA). The results indicated a significant difference in the behavioral inhibition-activation system between cannabis users and non-users ($P<0.05$). However, no significant difference was observed in problem-solving and resilience between the two groups. These findings suggest that cannabis use may alter the behavioral inhibition system and the behavioral activation system, while having minimal effect on problem-solving and resilience. Therefore, this research can serve as a basis for further studies on the psychological effects of cannabis use and appropriate intervention strategies to improve the condition of users.

Keywords: *Executive Functions, Resilience, Problem Solving, Behavioral Inhibition-Activation.*

1. Introduction

In recent decades, given the high prevalence of cannabis use among adolescents and young adults, studying its effects on various psychological and social aspects has gained special importance. Cannabis is one of the most commonly used drugs, and due to its diverse cognitive and psychological effects, it has attracted researchers' attention

(1, 2). Marijuana, as a psychoactive substance, has multiple effects on the central nervous system that can lead to reduced cognitive abilities and changes in executive functions. Executive functions are a set of cognitive processes, including planning, attention, working memory, and response inhibition, which are essential for controlling behaviors and making individual decisions (3).

Numerous studies have shown that marijuana use can lead to deficits in these functions. Some demonstrated that marijuana use is associated with decreased working memory and attention (3-8). Additionally, marijuana use can lead to psychological problems such as anxiety, depression, and psychotic disorders (9-11). Moreover, marijuana is associated with reduced motivation and the development of amotivational syndrome, which can negatively impact academic and social performance. This issue is particularly critical in educational environments where students need high levels of focus and motivation (3, 7, 8, 10, 12, 13).

Frequent cannabis use can negatively affect executive functions and resilience, especially in younger age groups whose nervous systems are still developing and maturing. Executive functions, which include cognitive processes like problem-solving, attention control, and emotional regulation, play a vital role in daily functioning and adaptive abilities (6). These functions are directly influenced by drug use, and changes in these areas can lead to serious problems in personal and social life. Research has shown that cannabis use can lead to decreased executive functioning, which can have widespread implications for adaptive abilities and daily performance (14).

Resilience, defined as an individual's ability to cope with life's challenges and crises and return to their original state, is a critical psychological feature that can moderate the effects of cannabis use (15). Studies have shown that individuals with high resilience have a greater ability to cope with life's stresses and pressures and are less likely to experience psychological problems. In contrast, individuals with lower resilience are more susceptible to psychological harm (15-17). Examining the impact of cannabis use on resilience can help identify individuals' psychological strengths and weaknesses and develop effective intervention strategies.

Given the multifaceted effects of marijuana on cognition and the structure and function of the brain, and the significant heterogeneity in findings as well as the long-term consequences for the central nervous system that are not well understood, a comprehensive review is needed. Executive functions, a foundational aspect of cognition, include various cognitive processes and influence all individuals' lives depending on age, functionality, and health. Psychological resilience not only enhances an individual's ability to endure and adapt to problems but also maintains and even promotes mental health. Therefore, considering the importance of understanding the effects of marijuana on cognitive and psychological factors and the existing gaps in understanding marijuana's impacts, this study aims to examine and compare executive functions and resilience in cannabis users and non-users. This research investigates the differences in executive functions and resilience between cannabis users and non-users to provide a deeper insight into the psychological effects of this substance.

2. Methods and Materials

2.1. Study Design and Participants

The present study is a descriptive ex-post facto study. The statistical population includes all men and women over 18 years old. This study used convenience sampling, and the sample consisted of 60 individuals. To determine the sample size, Cochran's formula was used, and considering the population size with a 95% confidence level and a 5% sampling error, 100 individuals were selected as the sample size. Participants were sent a link to the questionnaire and asked to respond to the questions. Inclusion criteria included being over 18 years old, no severe physical or psychological illnesses, and willingness to participate in the study. Exclusion criteria included incomplete questionnaires and identification of specific medical or psychological conditions that might affect the study results.

2.2. Measures

2.2.1. Problem Solving

The Problem Solving Inventory consists of 35 questions designed by Heppner and Krauskopf in 1987 and 1988. It includes three components: confidence in problem-solving, approach-avoidance style, and personal control. The scoring is based on a Likert scale (from strongly disagree to strongly

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agree). Heppner and Krauskopf (1987, as cited in Larson, Penter, & Winstead, 1995) define problem-solving as a series of behavioral, cognitive, and emotional responses used to adapt to internal and external challenges. The 35 items in this test measure how individuals respond to daily issues, such as getting along with friends, feeling depressed, choosing a career, or deciding to divorce. The PSI measures an individual's awareness of their problem-solving style or abilities. The Problem Solving Inventory has been tested with various samples, showing relatively high internal consistency with alpha values ranging from .72 to .85 for subscales and .90 for the overall scale. The retest reliability of the total score over two weeks ranged from .83 to .89, indicating that the Problem Solving Inventory is a reliable tool for assessing problem-solving ability (18, 19).

2.2.2. *Resilience*

This scale was developed by Connor and Davidson in 2003. It consists of 25 questions and aims to measure resilience based on components such as personal competence, trust in personal instincts, tolerance of negative emotions, control, and spirituality. The response format is a Likert scale. The total score is obtained by summing all item scores, ranging from 0 to 100. Higher scores indicate greater resilience. The cut-off point for this scale is 50, meaning scores above 50 indicate resilient individuals, with higher scores representing higher resilience levels. Connor and Davidson reported a Cronbach's alpha of .89 for the resilience scale. The test-retest reliability over a four-week interval was .87 (20, 21).

2.2.3. *Behavioral Inhibition-Activation System*

This questionnaire consists of 24 questions designed by Carver and White in 1994. It includes three subscales: Behavioral Inhibition Sensitivity, Behavioral Activation Sensitivity: Drive, Reward Responsiveness, and Fun Seeking. The BIS/BAS system reflects individual differences in the sensitivity of the underlying neural system in response to environmental cues. These systems are the basis for individual differences, and the activity of each system elicits different emotional responses, such as fear and anxiety (22, 23). The Cronbach's alpha reliability coefficients for this questionnaire are .87.

2.3. *Data Analysis*

For data analysis, both descriptive and inferential statistical methods were used. The collected data were initially tested for normality using the Kolmogorov-Smirnov test. Given the normality of the data and the homogeneity of variances, Multivariate Analysis of Variance (MANOVA) was used to compare the study variables between the two groups.

3. Findings and Results

Table 1 presents the descriptive characteristics of the components of executive functions, problem-solving, behavioral inhibition-activation, and resilience, including the mean, standard deviation, and variance.

Table 1

Descriptive Statistics of Research Variables

Variables	N	Mean	Standard Deviation	Variance	Maximum	Minimum
Executive Functions (Users)	30	175.8	20.9	438.3	227	132
Executive Functions (Non-users)	30	172.5	14.1	199.8	196	148
Resilience (Users)	30	66.6	12.1	147.4	94	35
Resilience (Non-users)	30	60.8	13.2	174.8	91	26
Problem Solving (Users)	30	28.1	7.4	56	42	13
Problem Solving (Non-users)	30	29.8	5.9	35.2	39	17
Behavioral Inhibition-Activation (Users)	30	72.2	7.2	52.7	87	55
Behavioral Inhibition-Activation (Non-users)	30	68.9	4.8	23.8	82	62

To examine the significance of the difference between the scores of experiential avoidance in the two groups, multivariate analysis of variance (MANOVA) was used. Before conducting the MANOVA, the results of M Box, Mauchly's sphericity, and Levene's tests were checked to meet assumptions. Since the M Box test was not significant

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for any of the research variables, the homogeneity of variance-covariance matrices condition was met. Also, the non-significance of any variables in Levene's test indicates that the equality of intergroup variances condition was met, and the amount of error variance of the dependent variable was equal across groups. Finally, the results of Mauchly's test of sphericity showed that this test was significant for the experiential avoidance variable, and therefore, the assumption of sphericity was not met (Mauchly's W = 0.39; df = 2; p < .001). Thus, the Greenhouse-Geisser correction was used to analyze the univariate test results for within-group and interaction effects.

Table 2

Multivariate Analysis of Variance (MANOVA)

Variables	Mean Squares	df	F	Significance
Executive Functions	60.9	1	0.52	0.47
Problem Solving	21.4	1	0.87	0.35
Behavioral Inhibition	37.8	1	4.5	0.03
Behavioral Inhibition-Activation	23.9	1	4.12	0.04
Resilience	5.40	1	0.30	0.80

The results indicated no significant difference in executive functions between cannabis users and non-users (F = 0.52, Sig = 0.47). The analysis showed no significant difference in problem-solving between the two groups (F = 0.87, Sig = 0.35). A significant difference was observed in behavioral inhibition between cannabis users and non-users (F = 4.5, Sig = 0.03), indicating that cannabis use can negatively impact behavioral inhibition. There was also a significant difference in behavioral inhibition-activation between the two groups (F = 4.12, Sig = 0.04), suggesting that cannabis use affects this system. No significant difference was observed in resilience between the two groups (F = 0.3, Sig = 0.8).

4. Discussion and Conclusion

The present study aimed to compare executive functions and resilience between cannabis users and non-users. The findings showed that there is a difference in the behavioral inhibition-activation system between cannabis users and non-users, but no significant difference in problem-solving and resilience between the two groups. The difference in the behavioral inhibition and activation system found in this study is consistent with several other studies (22-26). It can be inferred that these individuals show higher sensitivity to new stimuli, fear-inducing stimuli, or situations that may be associated with punishment or lack of reward in their living environment. The output of the behavioral activation system, which is activated by pleasant stimuli related to rewards, involves actively seeking rewarding stimuli regardless of the consequences ((22). Additionally, a review study examining cannabis and neurocognitive functioning concluded that neurocognitive performance in cannabis users is impaired (23).

The findings indicated a difference in the behavioral inhibition-activation system between cannabis users and non-users, but no significant difference in problem-solving and resilience between the two groups. These results suggest that cannabis use can impact certain aspects of executive functions, but its effect on resilience and problem-solving is limited. The results showed significant differences in the components of behavioral inhibition and the behavioral inhibition-activation system between users and non-users. These findings align with previous research indicating that cannabis use can significantly affect brain executive functions (22, 25). Specifically, the behavioral inhibition system, which plays a critical role in impulse control and preventing risky behaviors, is impaired in cannabis users (22, 24).

The results indicated a significant difference in the behavioral inhibition-activation system between cannabis users and non-users. This finding aligns with previous research showing that cannabis use can impact neurocognitive systems (2, 4, 14, 27). It appears that cannabis users are more sensitive to new stimuli, fear-inducing stimuli, and potential punishment situations, and as such, they may react differently to these stimuli compared to non-users. Research has shown that the behavioral inhibition system (BIS) and behavioral activation system (BAS)

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function differently in these individuals, leading to changes in behavior and reactions (2, 27).

Regarding problem-solving, the results showed no significant difference between the two groups. This finding suggests that cannabis use may not affect overall problem-solving abilities. However, some research has shown that long-term cannabis use can negatively impact complex cognitive functions (2, 4).

The findings indicated no significant difference in problem-solving between cannabis users and non-users. This result may indicate that problem-solving ability, as a complex executive function, may not be affected by cannabis use, or at least in the short term and controlled conditions, there is no significant difference between the two groups. Some studies have shown that short-term cannabis use does not significantly impact cognitive abilities, but chronic and long-term use may lead to structural and functional changes in the brain that can affect problem-solving and other executive functions (2, 6, 12, 26). Therefore, longitudinal studies and long-term follow-ups can help clarify the effects of cannabis use on problem-solving.

The findings indicate no significant difference in resilience between the two groups. Resilience, as a psychological trait that enables individuals to cope with life's stresses and challenges, does not appear to be directly affected by cannabis use. This finding aligns with some previous research indicating that resilience, as a relatively stable trait, is not affected by substance use (17). Resilience, defined as the ability to cope with stress and return to equilibrium after facing difficult situations, can be influenced by various factors, including personality traits, social support, and life experiences. The findings suggest that cannabis use does not significantly impact resilience, possibly due to the complexity of this psychological trait and the multiple factors influencing it. In other words, resilience may depend more on individual and environmental factors than on the use or non-use of specific substances (17).

It should be noted that executive functions and resilience in cannabis users depend on complex conditions and components that require further research. This study had several limitations. First, causality cannot be inferred from comparative studies. Second, the sample size was limited, and the lack of precise information on the amount and intensity of cannabis use, the purpose of use, the age of onset, the duration of abstinence, and the number of relapses were other limitations of the research. Based on this, researchers are advised to investigate various aspects of executive functions in larger samples in future research to increase the range and generalizability of the results. Furthermore, future research should carefully examine deficits in executive functions with reference to parameters affecting cannabis use and the interaction of these factors with the age of onset, IQ, personality traits, duration of use, and number of relapses.

This study had several limitations that should be considered when interpreting the results. First, causality cannot be inferred from comparative studies. Second, the sample size was limited, and the lack of precise information on the amount and intensity of cannabis use, the purpose of use, the age of onset, the duration of abstinence, and the number of relapses were other limitations of the research. To address these limitations and increase the accuracy and generalizability of the results, it is suggested that future studies use larger and more diverse samples and collect more detailed information on cannabis use patterns. Given the negative effects of cannabis on the behavioral inhibition-activation system, there is a need to raise public awareness of these effects. This awareness can be communicated to the public through educational programs and informational campaigns. Prevention programs should emphasize the negative impacts of cannabis on executive functions and resilience. These programs can help reduce cannabis use in the community. Providing support and treatment services to cannabis users, especially those experiencing functional and resilience issues, is essential. These services can help improve the psychological and social well-being of these individuals.

Authors' Contributions

E.A. conceptualized the study, developed the research questions, and designed the methodology. M.C. conducted the data collection and managed the participant recruitment process. Both authors collaborated on the data analysis using Multivariate Analysis of Variance (MANOVA) and interpreted the findings. E.A. wrote the initial draft of the manuscript, while M.C. provided critical revisions and contributed to the theoretical background. Both authors

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reviewed the final manuscript and approved it for publication.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki.

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