



A thinking games program for adolescents in a situation of psychoactive-substance dependence


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Objective: to analyze the impacts of the application of a program using thinking games based on the Mind Lab methodology on the executive functions: attention, flexibility and planning in adolescents in a situation of psychoactive-substance dependence. **Method:** quasi-experimental quantitative study with the application of neuropsychological assessment tools before and after intervention. Thirty-five adolescents aged 12 to 17 years old, admitted to an Integrated Mental Health Care Center in the city of São Paulo, participated in this study. **Results:** there was evidence of attention improvement after application of the games program. Regarding the planning and flexibility functions, improvements were observed, but they were not significant. **Conclusion:** it was possible to observe the importance of using thinking games as a playful resource in the treatment of substance-dependent adolescents, thus enabling the construction of strategies that assist in their recovery and rehabilitation process.

Descriptors: Adolescents; Executive Function; Metacognition; Substance Dependence.

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Programa com jogos de raciocínio para adolescentes em situação de dependência de substâncias psicoativas

Objetivo: verificar impactos da aplicação de um programa com uso de jogos de raciocínio embasado na metodologia *Mind Lab* nas funções executivas atenção, flexibilidade e planejamento em adolescentes em situação de dependência de substâncias psicoativas. **Método:** estudo quantitativo quase-experimental com aplicação de instrumentos de avaliação neuropsicológica pré e pós-intervenção. Participaram 35 adolescentes com idades entre 12 e 17 anos internados em um Centro de Atenção Integrada à Saúde Mental na cidade de São Paulo. **Resultados:** evidenciou-se melhora na atenção após a aplicação do programa com jogos. Quanto às funções planejamento e flexibilidade, foram observadas melhoras, porém estas não foram significativas. **Conclusão:** foi possível verificar a importância da utilização de jogos de raciocínio como recurso lúdico no tratamento de adolescentes em condição de dependência de substâncias psicoativas, possibilitando a construção de estratégias que auxiliem no processo de recuperação e reabilitação.

Descritores: Adolescentes; Função Executiva; Metacognição; Dependência de Substâncias Psicoativas.

Programa con juegos de pensamiento para adolescentes en situación de dependencia a sustancias psicoactivas

Objetivo: verificar impactos de la aplicación de un programa utilizando juegos de pensamiento basados en la metodología *Mind Lab* sobre las funciones ejecutivas de atención, flexibilidad y planificación en adolescentes en situación de dependencia a sustancias psicoactivas. **Método:** estudio cuantitativo cuasiexperimental con aplicación de instrumentos de evaluación neuropsicológica antes y después de la intervención. Treinta y cinco adolescentes de 12 a 17 años, ingresados en un Centro Integrado de Atención de Salud Mental en la ciudad de São Paulo, participaron en este estudio. **Resultados:** hubo evidencia de mejora en la atención después de la aplicación del programa con juegos. Con respecto a las funciones de planificación y flexibilidad, se observaron mejoras, pero estas no fueron significativas. **Conclusión:** fue posible verificar la importancia del uso de juegos de pensamiento como recurso lúdico en el tratamiento de adolescentes en condición de dependencia de sustancias psicoactivas, permitiendo la construcción de estrategias que ayuden en el proceso de recuperación y rehabilitación.

Descriptor: Adolescentes; Función Ejecutiva; Metacognición; Dependencia a Sustancias.

Introduction

Dependence on psychoactive substances (PASs) consists of behavioral, physiological and cognitive changes, characterizing a mental health condition described by frequent, compulsive substance use aimed at avoiding withdrawal symptoms and accompanied by physical, psychological and social problems⁽¹⁻²⁾. It is a problem that requires special attention in adolescence, as this is a critical developmental trajectory. It is in such context that concerns associated with PAS use arise in this phase of life, considering that the consequences resulting from substance use can be more harmful than those observed in adult life - this is because, on the one hand, there are the existential specificities of this life trajectory and, on the other, neurochemical issues due to brain maturation⁽³⁻⁴⁾.

Unlike that of an adult, an adolescent's brain is still in the process of development, with several regions undergoing formation, such as the structures responsible for the so-called social brain and several others that are part of the reward pathway⁽⁵⁻⁶⁾. Although a developing brain is more resilient to neurotoxic effects, the use of alcohol and other substances during a critical period of neurological development can disrupt the brain's natural course of maturation as well as other processes that are key to its development.

Impairment in executive functions have been associated with risks and consequences of PAS dependence in previous studies⁽⁷⁻⁹⁾, and impairment in the attention, memory, behavior (e.g. impulsivity) and affectivity domains is highlighted. Executive functions involve a broad spectrum of behavioral and cognitive skills that are important resources for optimizing responses to environmental and personal challenges in order to maximize reward opportunities and achieve long-term goals⁽⁹⁾. Interventions aimed at the development of such functions can be promising in the treatment and rehabilitation of patients with PAS-dependence conditions⁽¹⁰⁾, especially for adolescents, since, if on the one hand, risk factors related to adolescents' neural and cognitive development operate, on the other, there are protective aspects that the same attributes can promote - brain adaptability and flexibility (neural plasticity)⁽¹¹⁾.

The use of thinking games as a resource in the treatment of PAS-dependent adolescents is based on the assumption that the Mind Lab methodology⁽¹⁰⁾, which has been created for the educational environment, when applied in the clinical context, could collaborate to improve executive functions. Games are privileged resources for exploring different cognitive and social aspects, as they make it possible to work with rules and strategies in different relational contexts. Through thinking games, it is possible to exercise attitudes of respect for the other's turn, data analysis, as well as attention,

flexibility, planning and decision-making functions⁽¹²⁾. In the proposed methodology, the participants learn metacognitive methods developed by Mind Lab, which are applied in the game situation and then transferred, through the mediator's intentional actions, to coping with everyday situations⁽¹⁰⁾.

This study is relevant for knowledge production in the field of mental health, making it possible to expand intervention resources for the recovery and rehabilitation of adolescents in situations of PAS-dependence. To our knowledge, few studies have addressed interventions aimed at promoting improvements in the executive functions of this population. Likewise, the use of intentional mediations, through thinking games as a resource in the treatment of patients with PAS dependence, is still incipient⁽¹⁰⁾.

Therefore, this study aimed to analyze the impacts of the application of a program using thinking games based on the Mind Lab methodology on executive functions: attention, flexibility and planning in adolescents in a situation of dependence on psychoactive substances admitted for drug treatment to an Integrated Mental Health Care Center (CAISM) in the city of São Paulo.

Method

The method proposed for this study is based on a quantitative perspective. It has a quasi-experimental design with pre- and post-testing. Such an investigative methodology is indicated for studies in which the experimental method is impossible due to the difficulty in accessing the problem or the investigated population⁽¹³⁾. The application of this methodological strategy is adequate to the proposed work, since the study on the investigated population has been previously described as challenging, considering that adolescents show high resistance levels, difficulties in treatment adherence and high abandonment rates⁽¹⁴⁻¹⁷⁾.

The study comprised two stages. The first stage aimed to characterize the population according to PAS use, and the second aimed to assess the impacts of the Mind Lab methodology, using thinking games in the functions of attention, planning and flexibility. Both stages were carried out at the Children and Adolescents' Center (NIA) of CAISM Philippe Pinel in the city of São Paulo. NIA attends only to male PAS-dependent children and adolescents. There are twelve beds available at this clinic, and the hospitalization protocol is for a mean period of thirty days, although many patients are discharged before that length of time has elapsed.

The first stage involved thirty-five adolescents who were admitted to the institution during the data collection period and who met the following inclusion criteria: being between 12 and 17 years old; not showing decompensated psychiatric comorbidities (active psychotic symptoms,

severe mood bias, psychomotor agitation, severe cognitive impairment). For the second stage of the study, only adolescents who had participated in at least 50% of the intervention sessions with the games and performed all pre- and post-intervention tests were considered.

Of the thirty-five adolescents who participated in the first stage of the study and started participating in the game sessions, some were discharged during

the intervention or before the application of the post-intervention tests. Another reason for the loss of participants was the invalidation of some instruments due to refusal to complete them. Figure 1 illustrates the methodological design and the number of participants in each stage of the study and according to the neuropsychological assessment tests before and after the intervention (T0 and T1, respectively).

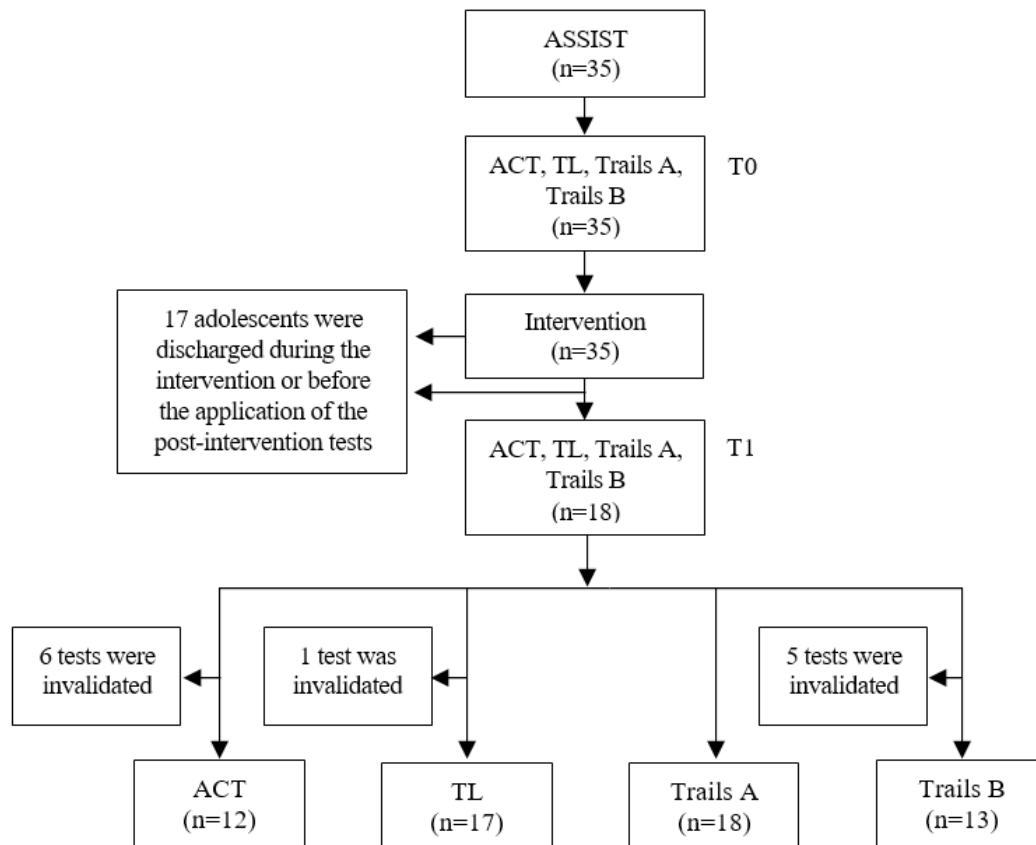


Figure 1 – Methodological design and number of participants according to test types

The first assessment battery (T0) occurred at least 72 hours after the adolescent's admission to NIA (following the detoxification peak), and the intervention began in the second week of participants' hospitalization. As the dates of adolescents' admittance to NIA varied, six groups were formed to participate in the sessions with thinking games using the Mind Lab methodology, which took place from September 2017 to August 2018, as described in Table 1.

Table 1 – Description of groups and intervention periods for 35 adolescents admitted to CAISM Philippe Pinel, from 2017 to 2018. São Paulo, SP, Brazil, 2018

Group	Intervention period	n at T0	n at T1
1	09/18/2017 to 09/29/2017	10	6
2	03/19/2018 to 03/30/2018	8	4
3	04/23/2018 to 05/11/2018	6	3
4	05/28/2018 to 06/15/2018	4	3
5	07/09/2018 to 07/27/2018	4	2
6	08/13/2018 to 08/31/2018	3	0
Total		35	18

The game sessions were applied by NIA professionals who were experienced in treating PAS-dependent individuals, including the nursing team, psychologists and occupational therapists. These professionals were previously trained by the researchers, initially for 30 hours (before application, including 16 hours of on-site and 14 hours of distance training) and 10 hours of continuing training (during the application phase of the program with the adolescents). During the initial training, in addition to studying the theoretical bases of the Mind Lab methodology, the professionals experienced the program that they would apply to patients. Continuing training was an opportunity for exchanging experiences and guidance.

The program with thinking games applied to the adolescents consisted of ten sessions lasting one hour and a half, five times a week (Monday to Friday), with a total duration of 15 hours. After the end of the ten sessions in each group, the NIA team contacted the researchers and scheduled the application of the post-intervention neuropsychological assessment tests within seven days. Due to NIA's activities and the number of tests and participants, data collection occurred on two consecutive days. The data were collected in a room inside NIA's facilities which was made available by the local team for that purpose. The tests were applied by the researchers individually and lasted, on average, 90 minutes for total application.

The project was structured in four work axes, namely:

1st axis: "the problems and I" (the "Rush Hour" game). Rush Hour is a game consisting of a board that simulates a parking lot, 16 pieces representing miniatures of colorful cars and 40 challenge cards. Each card illustrates a position according to which the cars must be placed on the board to start the game. The objective is to remove the red-colored car from the "parking lot", with the pieces moving only forward or backward, in the position in which they are (horizontally or vertically). It is a challenge game that can be played individually, in pairs or in small groups; it is not a game of opponents;

2nd axis: "the other and I" ("Game of 4"). The Game of 4 is a game of opponents consisting of a board with 16 squares, eight dark pieces and eight light pieces of different shapes (e.g. a cylinder, a square, a taller or a shorter piece, among others). The objective is to be the first player to make a sequence along a line, a column or a diagonal line with four pieces that have at least one characteristic in common (for example, all being square). To win the game, the player must say "four" to indicate that he/she has noticed the formation of a sequence.

3rd axis: "society and I" ("United Forces and Chinese Checkers"). United Forces is a game of opponents consisting of a hexagonal board, 12 dark spheres and 12 light spheres. The game starts with all the pieces on the board, and the objective is to push six of the opponent's spheres off the board (by the edge) following the rules of movement of the pieces. The Chinese Checkers game is also a game of opponents with a board containing 64 squares, nine light pieces and nine dark pieces. The game starts with all the pieces on the board and arranged in an equivalent way in two opposite quadrants. The objective of the game is to move all nine pieces to the other side of the board, following the rules of movement, until placing them in the position where the opponent's pieces started the game.

4th axis: "I with myself, with the other and with society" (all games, methods and strategies studied throughout the process).

Each game was used in two sessions, and in all of them, transcendences were promoted, that is, reflections on how to apply the learning built through the experience with games in maintaining health and avoiding PASs. Two meetings were also promoted by the professionals for the resumption of the studied games, with closure, reflections and recording of the most significant learning built through the experiences mediated by the games: one in the middle of the process and another at the end of it.

In order to outline the participants' profiles before the program began, the team of Mind Lab researchers applied the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) to the adolescents. This is an instrument for screening PAS use which was developed by researchers from several countries under coordination by the World Health Organization (WHO)⁽¹⁸⁾ and has already been validated in Brazil⁽¹⁹⁾. ASSIST consists of eight questions on the use and problems related to various substances (tobacco, alcohol, marijuana, cocaine/crack, amphetamines or ecstasy, inhalants, hypnotics/sedatives, hallucinogens and opioids) and the use of injectable substances. Participants were asked to answer questions based on the last three months before admission to the center. The score of each participant in this instrument is given by substance and can vary from 0 to 31 for tobacco and from 0 to 39 for other substances. The scores of the participants in this instrument were classified according to the risk criteria for problems related to PAS use, including the development of substance use disorders and psychosocial problems, as established by WHO. The cutoff points adopted were: low risk (0-10 for alcohol and 0-3 for the other PASs), medium risk (11-26 for alcohol and 4-26 for the other PASs) and high risk (27 or more)⁽¹⁸⁾. For additional information on the PAS use profile, such as

the main drug leading to hospitalization, the participants' medical records were consulted.

In order to evaluate the executive functions, the following neuropsychological assessment instruments were applied: Attention Cancellation Test (ACT; attention assessment), Trail Making Test (attention and cognitive flexibility) and Tower of London (TL; planning). These instruments were applied by the researchers before and after the application of the Mind Lab program using thinking games.

The Attention Cancellation Test (ACT)⁽²⁰⁾ consists of three parts. For each part, a different matrix is printed with different types of stimuli, and the participant's task is to mark all stimuli equal to a previously determined target stimulus. The first part of the test assesses selective attention, which corresponds to the ability to pay attention to a target stimulus among others that are presented simultaneously. The maximum time for performing the task is one minute, and the maximum score of correct answers that can be achieved is 50 points. The second part of the ACT also assesses selective attention, but with a greater degree of difficulty. The maximum time for this part is also one minute and the maximum score that can be achieved is seven points. The last part evaluates alternating attention, which corresponds to the participant's ability to change the focus of attention. The maximum time to perform this part is one minute, and the maximum score is 52 points. For this study, the correction and scoring criterion based on the total number of correct answers minus the number of errors⁽²⁰⁾ was used, so that higher scores show better attention function. The evaluation by this instrument was based on the variation of the mean scores in the tests at T0 and T1.

The Trail Making Test consists of two parts (A and B)⁽²¹⁾. Part A assesses sustained visual attention, which refers to the ability to maintain the focus of attention over time. This part comprises the random presentation of twelve letters or numbers, and the participant's task is to link them in numerical or alphabetical order. Part B assesses cognitive flexibility, which corresponds to the ability to switch attention to perform a task. In this part of the test, letters and numbers are randomly presented, and the participant's task is to link them alternately and in numerical and alphabetical order (e.g. 1-A-2-B-3-C, and so on). In both parts, participants are instructed to perform the tasks without removing the pencil from the paper, and the evaluator clocks the execution time of each part. If a participant makes a mistake, the evaluator asks him/her to return to the beginning of the task so that the more mistakes are made, the longer the time spent by the participant. The evaluation using this instrument was based on the standard mean⁽²¹⁾, which is established according to the participants' level of education. The result is given by a standard score, which corresponds to the

amount of standard deviation above or below the mean expected for that level of education. Thus, a higher score on this instrument shows better sustained attention (Part A) and flexibility (Part B).

The Tower of London Test⁽²²⁾ assesses the executive planning function, which corresponds to the ability to plan actions to achieve an objective. The test consists of three vertical rods and three colored spheres. The participant must perform the task of transposing the three spheres from a fixed initial position, in order to reach the final dispositions specified by the evaluator. Difficulty levels gradually increase according to the number of steps required to reach the final position (ranging from two to five movements). The evaluation by this instrument considers the solution reached by the participant with the minimum number of actions as the correct answer, and the answers can correspond to one, two or three points, as they are reached in the third, second or first attempt, respectively. The maximum possible score is 36 points, and the higher the score, the better the performance of the planning function.

The data were analyzed using the IBM SPSS program, version 25⁽²³⁾. A 0.05 significance level was adopted. Due to the small number of participants and the non-adherence to the normal distribution of variables, the Wilcoxon Test for paired samples was used in order to analyze possible differences in the means in the ACT, Trails and Tower of London tests at T0 and T1. The effect size (r) of the significant differences between the means was also calculated, whose interpretation was: small effect (from 0.10 to 0.29), moderate effect (from 0.30 to 0.49) and large effect (equal to or greater than 0.5)⁽²⁴⁾.

The application of an analysis test of paired samples requires the same number of participants in the pre- and post-intervention tests; therefore, only the adolescents who participated in at least 50% of the game workshops and performed all pre- and post-intervention tests were considered for the second stage of the study. As there was no control group, 0 (zero) was the expected variation in the test results.

The project was approved by the Research Ethics Committee of *Faculdade de Ciências da Saúde de São Paulo* (CAAE 80249417.6.0000.5399), according to report no. 2.400.515, and it was conducted in accordance with Resolutions 466/2012 and 510/2016. Participants' confidentiality and security were ensured throughout the research process.

Results

The participants' mean age was 15.4 years, with a standard deviation of 1.37. As for their education, the mean schooling was of 7.4 years ($SD=2.27$). A significant number of participants lived in the Greater São Paulo area (48.5%), while another part was distributed in inner

São Paulo state (28.6%) or came from other states in Brazil (22.9%).

Regarding the PAS use profile, it was observed that, among the 35 adolescents who participated in the first stage of the study, marijuana and cocaine were the substances showing the highest use, representing a high risk for the development of disorders related to substance use and psychosocial problems, as shown in Table 2. The mean score for marijuana was 29.6 (SD=10.3), and for cocaine, it was 27.9 (SD=12.8). Cocaine was the main drug leading to the hospitalization of adolescents participating in the study, according to the medical records consulted. Although ASSIST addresses cocaine and crack in the same category, most participants reported not being involved in the use of crack. Participants also reported moderate use of other substances (amphetamines, hypnotic inhalants, sedatives, hallucinogens). No participants reported the use of injectable substances.

Table 2 – Score and risk by psychoactive-substance type of 35 adolescents admitted to CAISM and evaluated by ASSIST, from 2017 to 2018. São Paulo, SP, Brazil, 2018

Substance	M (SD) [*] (n=35)	Risk
Tobacco products	22.1 (7.8)	Medium
Alcohol	16.4 (12.1)	Medium
Marijuana	29.6 (10.3)	High
Cocaine/crack	27.9 (12.8)	High
Amphetamines	9.6 (12.9)	Medium
Inhalants	11.3 (13.2)	Medium
Hypnotics, sedatives	3.6 (9.6)	Medium
Hallucinogens	4.6 (9.8)	Medium
Opiates	1.4 (5.4)	Low
Others	0.1 (0.3)	Low

*M (SD) = Mean and Standard Deviation

The results of the neuropsychological assessments at T0 and T1 are described in Table 3.

Table 3 – Scores of neuropsychological assessment tests at T0 and T1, from 2017 to 2018. São Paulo, SP, Brazil, 2018

Instrument	n	Pre-intervention assessment (T0)		Post-intervention assessment (T1)		p-value [†]	Effect size (r)
		Median	M (SD) [*]	Median	M (SD) [*]		
ACT [‡]	12	49	41,1 (37.7)	75	80.0 (24.7)	0.008	0.77
TL [§]	17	27	26.9 (5.1)	27	27.4 (3.2)	0.816	-
Trails (part A)	18	-0.10	-0.46 (1.83)	-0,10	0.14 (1.71)	0.007	0.63
Trails (parte B)	13	0.60	0.74 (0.43)	0,60	0.80 (0.44)	0.461	-

*M(SD) = Mean and Standard Deviation; [†]Paired Wilcoxon Test; [‡]ACT Attention Cancellation Test; [§]TL = Tower of London Test

As regards ACT, an increase in participants' scores was shown between T0 and T1 (p-value=0.008), indicating an improvement in this executive function. Also, there was a large effect size for this variable (r=0.77).

Regarding the planning function, assessed by the TL test, there was a 0.5-point increase in the mean score between T0 and T1; however, such variation was not significant (p-value=0.816).

In the Trails Test, part A, there was a 0.60-point mean variation between the mean scores in the assessments at T0 and T1 (p-value=0.007), indicating an improvement in sustained attention.

As to the cognitive flexibility function, assessed by part B of the Trails Test, there was no evolution in the mean between T0 and T1 (p-value=0.461), thus showing that there was no significant variation for this variable at T1.

Discussion

In this study, the substances showing the greatest use by the participating population were marijuana and cocaine. According to the classification proposed by WHO, which was used in this study, the use profile

of these substances in the participating adolescents is considered of high risk for PAS abuse and dependence and psychosocial problems. By consulting their medical records, cocaine was identified as the main substance leading the participants to hospitalization. These findings are opposed to those from other studies, which indicate alcohol as the substance most often used in the world and prominent among adolescents⁽²⁵⁻²⁶⁾. To our knowledge, there are no studies on populations in similar contexts that corroborate these findings, drawing attention to the distinct characteristics of adolescents in situations of vulnerability who develop PAS-dependence conditions and other adolescents who do not.

Several aspects are involved in PAS use in adolescence, among which are the intense biopsychosocial changes and the identity-development process in this period, curiosity, lack of information, parental and social models, myths and expectations related to substance effect, pressure from the industry and the communication media, in addition to other contexts and risk factors that deserve to be highlighted and can cause dependence conditions⁽²⁵⁻²⁶⁾. For an adequate understanding of the

PAS-use profile in the studied population, it is important to highlight that the phenomenon of addiction in adolescents has nuances and peculiarities depending on individual, socioeconomic and demographic characteristics. Also, a noteworthy risk factor that is widely discussed in the literature is the lack of support from family and social structures⁽²⁷⁻²⁹⁾.

A study pointed to the need for developing effective intervention programs and strategies for adolescents, given the increase in the prevalence of PAS-dependence conditions in this population, highlighting the importance of playful interventional methodologies which, by taking into account the singularity and subjectivity of adolescents, as well as the contexts that they experience, can favor decision making and future choices⁽¹²⁾. The use of thinking games as a therapeutic resource is part of this perspective, promoting the development of cognitive, social and emotional skills that can help in the decision-making, reflection and planning processes as well as with the internalization of attitudes and values concerning health, especially in the face of risky situations.

This study highlighted that there was an improvement in the attention of adolescents participating in the games program using the Mind Lab methodology. This result corroborates the findings of another study that used the same methodology with PAS-dependent adult patients⁽¹⁰⁾.

As pointed out in the literature, deficits and attention problems have been associated with PAS use, particularly with the that of cocaine, being also related to greater sensitivity in the reward system, in such a way that there is a tendency for these patients to make decisions seeking immediate rewards, which can be directly associated with PAS use⁽³⁰⁻³¹⁾. Improvements in the attention function in young patients can, therefore, provide an effective possibility that will help them in making decisions and recovering the reward and impulsivity system.

As for the planning and cognitive flexibility functions, although they showed improvements between pre- and post-intervention testing in the adolescents participating in this study, they were not significant and require further investigation in future studies. It is important to emphasize that in the proposed Mind Lab methodology, the use of thinking games is added to the use of metacognitive methods and intentional and planned mediation actions by a health professional, stimulating the transcendence and generalization of game learning to reflections and the development of strategies that can be applied in everyday life.

Other studies support the emphasis on the possibility of using these strategies for the rehabilitation of executive functions, in addition to being a promising therapeutic path that can help with long-term benefits and also be easily

used in public and private clinics for PAS-dependence treatment⁽³²⁾.

Conclusion

The results allowed to consider the importance of using thinking games with the Mind Lab methodology in the treatment of the studied population. Improvements were observed in the executive functions investigated in the adolescents participating in the game program, although the planning and flexibility functions did not show improvements. The proposed methodology enabled to strengthen the bond between hospitalized patients and the service team, constituting an activity of interest to adolescents, and, consequently, indirectly resulting in greater adherence to treatment.

The differential of the present study lies in the practical application of new strategies and resources in the treatment of adolescents with PAS dependence. The results support the application of playful interventional methodologies that favor the development of cognitive and social aspects, as well as the expression of feelings and reflection on everyday life situations.

The limitations to this study are the non-random selection of and limitation from the number of participants, which prevent the generalization of results. It is recommended that future research should have a larger population in order to test the effectiveness of the Mind Lab methodology in the treatment of PAS-dependent adolescents. It is also suggested that longitudinal studies should be conducted in order to analyze whether improvement in executive functions can promote health maintenance after the hospitalization period. Finally, the importance of developing research that proposes interventions and the verification of their effectiveness is highlighted, with a view to developing methodologies and adequate therapeutic resources to treat PAS-dependent adolescents.

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