Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200

JFH

Original research

Comparing the effectiveness of transactional behavior analysis therapy and transcranial direct electrical stimulation therapy on anxiety and quality of life in first-year high school students with attention deficit hyperactivity disorder

Sonia Jahedi,[1] Morteza Tarkhan[*2], Morvarid Ahadi[3], Parvaneh Ghodsi[4]

Abstract

Introduction: The present study was conducted with the aim of comparing the effectiveness of interactional behavior analysis therapy and transcranial direct electrical stimulation therapy on anxiety and quality of life of first-grade high school students with attention deficit hyperactivity disorder.

Research methods: The current research was of applied type and a semi-experimental design of pre-test, post-test, and follow-up with a control group. The statistical population of the research consisted of students (boys and girls) with hyperactivity disorder and attention deficit disorder in special schools of Rasht city in the academic year of 2023-2024. The number of people in the current research sample is 45 people, and the share of each group is 15 people who were selected by purposeful sampling. The research tools were Weir et al.'s quality of life questionnaire (1988), Beck's anxiety questionnaire (1990), the standard attention deficit hyperactivity disorder questionnaire, and Swanson, Nolan, and Pelham (1981). The methods of data analysis were multivariate covariance, multivariate covariance analysis, univariate covariance analysis, and Tukey's post hoc test.

Findings: The results of the research showed that there is a difference of 0.01 between the effectiveness of group training, interaction behavior analysis therapy, and transcranial direct electrical stimulation therapy on anxiety and quality of life of children with attention deficit hyperactivity disorder.

Conclusion: From the findings it can be concluded that interactional behavior analysis treatment and transcranial direct electrical stimulation treatment are effective in quality of life and anxiety in first-grade high school students with attention deficit hyperactivity disorder.

Keywords: Anxiety, Attention deficit hyperactivity disorder**,** direct transcranial electrical stimulation treatment, Quality of life, Reciprocal behavior analysis treatment

Received: 2024/8/2 **Accepted: 2024/11/20**

Citation: Jahedi S, Tarkhan M, Ahadi M, Ghodsi P. Comparing the effectiveness of transactional behavior analysis therapy and transcranial direct electrical stimulation therapy on anxiety and quality of life in first-year high school students with attention deficit hyperactivity disorder, Family and health, 2025; 14(4): 116-131

[1] - PhD Student, Department of Psychology, Kish International Branch, Islamic Azad University, Kish Island, Iran, Soniya.jahedi04@gmail.com

[2] - (**Corresponding author**), Associate Professor, Department of Psychology, Payam Noor University, Tehran, Iran mttmaster20@yahoo.com , tell: 09113920297

[3] - Associate Professor, Department of Psychiatry, University of Rehabilitation Sciences and Social Health, Tehran, Iran, morvaridahadi1360@gmail.com

[4] - Assistant Professor, Department of Psychology, Central Tehran Branch, Islamic Azad University, Tehran, Iran elham_ghodsi@yahoo.com

Introduction:

Children and adolescents often face behavioral difficulties, which can manifest in several disorders. Among these are bipolar disorder, known for its severe mood changes, anxiety, insomnia, and suicidal thoughts. Other prevalent conditions include attention deficit/hyperactivity disorder, anxiety disorders, aggression disorders, eating disorders, obsessive-compulsive disorder, oppositional defiant disorder, and compulsive masturbation (1). Bloomquist (2018) asserts that children experiencing behavioral issues and disorders present significant challenges for their parents. The behaviors exhibited by these children can have detrimental effects on those in their vicinity (2). Childhood disorders are typically divided into two main categories: externalizing disorders and internalizing disorders. Externalizing disorders manifest through behaviors like aggression, defiance, hyperactivity, and impulsivity, which are primarily directed outward (3). Children's behavioral issues can present in various forms, influenced by a multitude of factors. Among the most significant are biological, environmental, social, cultural, and familial influences. The examination of psychological issues in children and adolescents has consistently been a primary focus for psychologists. Notably, those with behavioral problems present a significant challenge for professionals in the field (4-7).

The involvement of parents is crucial in the development of certain behaviors, and one effective approach to addressing behavioral issues is to educate parents on appropriate parenting techniques. A family's understanding of effective parenting practices is often insufficient, and this gap in knowledge can lead to difficulties in forming healthy relationships with their children. The style of parenting is characterized by the balance of acceptance and strong relationships, as well as control and autonomy. Adopting an authoritative style can significantly diminish or eliminate behavioral problems in children. Different approaches can be utilized to teach parenting techniques. Some suggest focusing on cognitive and communicative management, typically opposing the use of behavioral methods like punishment, rewards, and reinforcement. In contrast, regarding parenting approaches, there are numerous strategies, such as training aimed at controlling children's unpredictable and abnormal behaviors, parent management programs that address behavioral difficulties, guidance on adopting a healthy parenting model, and efforts to coordinate parents within a unified parenting strategy. The interaction between parents and children is a complex and multidimensional process shaped by various essential factors. These include parental attitudes and acceptance levels, methods of behavior management and control, perceptions of social competence and self-regulation, parenting knowledge and skills, parental self-confidence and positive thinking in child-rearing, the establishment of a low-conflict environment, overarching issues in parent-child dynamics, and the emotional nurturing provided by the mother (8, 9).

The interaction between parents and children is crucial in the management of attention deficit hyperactivity disorder (ADHD). The DSM-5 indicates that this disorder is prevalent in society, contributing to lower quality of life and escalating treatment costs. In the context of ADHD treatment, the interaction between parents and their children aims to achieve two primary objectives. The primary objective is to inform parents about effective strategies that can alleviate symptoms of ADHD. The secondary objective focuses on enhancing the parent-child relationship and enriching the overall quality of family life. In this context, parents are acknowledged as vital contributors to the treatment team and play an active role in the therapeutic process. Educating parents about effective

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200
JFH

parenting techniques enables them to offer optimal support for their children during the treatment process. Furthermore, by actively engaging in their children's behaviors, parents can contribute to the improvement of ADHD symptoms through necessary lifestyle. By implementing a structured daily schedule, parents can offer their children a sense of discipline and organization. In addition, reducing the use of mobile phones and television, avoiding sugary foods, and establishing designated times for gaming and physical activity can significantly contribute to alleviating symptoms of attention deficit hyperactivity disorder (ADHD) (10-12).

Ultimately, strong communication between parents and their children is key to reducing anxiety and fostering self-confidence in children. By fostering a consistent and nurturing atmosphere, parents can significantly enhance their children's ADHD symptoms. Besides providing parents with knowledge on effective parenting strategies, the dynamics of parent-child interaction are essential in the multifaceted treatment of attention deficit hyperactivity disorder. Some of these aspects are mentioned below:

Correcting inappropriate behaviors: When parents engage in clear and constructive communication with their children, they can better identify behaviors that may be inappropriate. by motivating their children to engage in sports and physical activities, parents can assist in enhancing the management of ADHD symptoms. In general, the interaction between parents and children in the management of ADHD is a vital, collaborative process that significantly contributes to alleviating the symptoms of this condition. By fostering cooperation between parents and their children, it is possible to enhance ADHD symptoms and improve the overall quality of life for the children involved (Beasant et al., 2022). Non-invasive techniques for addressing a range of psychiatric, neurological, and psychological disorders include magnetic brain stimulation, transcranial electrical stimulation, neurofeedback, and biofeedback (11). Electrical brain stimulation is an overarching term that includes multiple methods, notably transcranial direct current stimulation (tDCS), transcranial random noise stimulation (tRNS), and transcranial alternating current stimulation (tACS) (12). In each of these techniques, a mild electrical current is delivered through conductive electrodes positioned on the scalp. These methods utilize electrodes of different shapes and sizes to facilitate the application of the current. Transcranial electrical stimulation, recognized as the most widely used type of transcranial electrical stimulation, has gained considerable traction in both studies and clinical practices in the past 15 years (Dunst, Trivette, Hamby, 2018).

Alternating current transcranial electrical stimulation has recently emerged as a significant contributor to brain mapping research, offering the capability to tailor stimulation frequency according to the brain's wave frequencies (13). Moreover, the application of transcranial electrical stimulation using random noise currents is increasingly being explored. Electrical stimulation is utilized in various therapeutic contexts, including the management of depression and migraines, rehabilitation following a stroke, and the mitigation of high-risk behaviors such as addiction, alcohol use, and smoking. Furthermore, it enhances cognitive functions, including memory, learning, attention, and mental flexibility (14). Numerous studies in this field indicate that transcranial electrical stimulation may be effective in alleviating symptoms associated with hyperactivity and oppositional defiant disorder. A study conducted in 2018 on children diagnosed with oppositional defiant disorder indicated that

transcranial electrical stimulation (TES) may enhance certain symptoms associated with the disorder, including attention, planning, and emotional regulation (8) .

Transcranial Electrical Stimulation: The justification for utilizing transcranial electrical stimulation in treating ADHD and oppositional defiant disorder rests on two significant aspects: its direct effects on neuronal activity and its ability to enhance the efficiency of the brain's neural networks .Transcranial electrical stimulation has a direct impact on neuronal activity by enhancing the potential of brain neurons, which can aid in the reconstruction and fortification of brain structure in children diagnosed with ADHD. In the context of depression treatment, transcranial electrical stimulation can enhance neuronal activity in the prefrontal cortex, leading to improved mood outcomes for patients Neural networks within the brain consist of interconnected neurons that interact and collaborate to execute a range of functions. The application of transcranial electrical stimulation can enhance and optimize these networks. In general, transcranial electrical stimulation has emerged as a valuable therapeutic approach for children diagnosed with attention deficit hyperactivity disorder (ADHD), primarily because of its direct influence on neuronal activity and its beneficial impact on neural networks (15).

Transactional behavior analysis therapy is a therapeutic approach grounded in behavioral and psychological theories. This method aims to enhance interpersonal relationships and alleviate anxiety among middle school students diagnosed with attention deficit hyperactivity disorder. Utilizing transactional behavior analysis therapy as a therapeutic technique can boost self-confidence and enhance the quality of life. Furthermore, direct transcranial electrical stimulation applies a low-level electrical current to designated areas of the brain, facilitating changes in brain function.

There is a lack of extensive research in this area. According to Yang et al. (2023), a holistic strategy that incorporates brain stimulation, 3D mental modeling, and reciprocal action can notably enhance and extend sustained 3D attention (16). The research conducted by Leffa et al. (2022) demonstrated that a daily regimen using a home-based transcranial direct current stimulation device for four weeks led to a significant reduction in inattention symptoms when compared to a sham treatment. Furthermore, the study found that transcranial direct current stimulation did not result in any serious adverse effects (17).

The study by Fergeni et al. (2021) focused on the application of electrical brain stimulation to the left prefrontal cortex in patients experiencing major depression (18). Ten subjects were randomly allocated to receive either active treatment or a sham intervention. During the active phase, participants underwent five days of intermittent treatment. The active treatment group exhibited a notable reduction in scores on both the Hamilton Depression Rating Scale and the Beck Depression Inventory, whereas no such changes were observed in the sham treatment group.

According to the study by Zettin et al. (2021), the application of direct cranial nerve stimulation, when utilized alongside therapies like speech and language therapy, aphasia therapy due to restriction, or intensive intervention therapy, enhances the overall recovery of impaired functions. Alongside these rehabilitation protocols, therapeutic observation seems to play a role in alleviating anomie following a stroke. Shareh and Bayani (19) conducted a study that compared the effectiveness of Transcranial Electrical Stimulation (TDCS) and Cognitive Behavioral Therapy (CBT) on smoking cravings, mood,

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200
JFH

and dependence. The study's results showed that both TDCS and CBT effectively reduced smoking, with TDCS resulting in a greater decrease. The application of transcranial electrical stimulation resulted in marked improvements in both positive and negative affect, in contrast to cognitive behavioral therapy, which only showed a significant effect on negative affect in smokers. Despite the fact that transcranial electrical stimulation contributed to greater improvements in negative affect and significantly lowered cigarette dependence, cognitive behavioral therapy was not successful in achieving similar results.

Thus, the primary objective of employing transcranial electrical stimulation is to address mental health issues and disorders. Given the materials outlined above, this study aims to address the following question, drawing upon theoretical frameworks and insights from existing research: Is the combination of group training in transactional behavior analysis therapy and transcranial direct electrical stimulation (TDS) therapy effective in reducing anxiety and enhancing the quality of life among first-year high school students who have attention deficit hyperactivity disorder? Is there a distinction in the effectiveness of transactional behavior analysis treatment compared to direct transcranial electrical stimulation (TTS) treatment, as well as the combined effects of these two approaches on anxiety and quality of life among first-year high school students diagnosed with attention deficit hyperactivity disorder?

Research Method:

The current research employed a quasi-experimental design featuring pre-tests and post-tests across four distinct groups. The statistical population for this study consisted of all students, both male and female, diagnosed with ADHD in special schools located in Rasht during the 2022-2023 academic year. The study necessitated a sample size of 60 participants, with 15 individuals allocated to each of the three groups. This calculation was based on the anticipated attrition rate for each sample group, as outlined in Cohen's table. The sampling technique applied in this research was purposive sampling. Initially, 60 students diagnosed with attention deficit hyperactivity disorder in Rasht were selected based on specific entry criteria. These participants, who were willing to engage in the study and had provided written consent, were chosen through a method of random replacement. Participants were randomly allocated to one of three groups: the first experimental group focused on group training in interactional behavior analysis therapy, the second experimental group centered on group training in transcranial direct electrical stimulation therapy, and the third group served as a control, determined through a random number table. The criteria for inclusion in this study are as follows: participants must be aged between 12 and 15 years and diagnosed with attention deficit hyperactivity disorder based on DSM-5 standards, as assessed by the researcher through a questionnaire and diagnostic interview. Throughout the duration of the study, participants are required to refrain from engaging in psychotherapy programs or altering their medication regimens outside of the educational and therapeutic interventions provided by the research. Additionally, they must be undergoing treatment with Ritalin. The criteria for exclusion from this study are as follows: non-participation or absence from more than two sessions, as well as not completing homework for more than two sessions. Tools:

Quality of life questionnaire SF-36: The design of this questionnaire, established by Weir et al. in 1988, offers a comprehensive approach to measuring quality of life in relation to health-related concerns. This questionnaire assesses eight dimensions, including physical functioning, physical

health limitations, emotional issues, energy and vitality, emotional well-being, social functioning, pain, and overall health. It offers 36 response options that can be completed by the individual or through an interview format. The tool is applicable to various age groups starting from 12 years and can be utilized for different health conditions. The reliability and validity of this questionnaire was confirmed by Weir and colleagues in 1988. It assesses individuals' perceptions of their quality of life across eight dimensions, with scores that vary from zero to 100. A score of 100 represents the optimal scenario, while a score of zero signifies the most unfavorable situation across each dimension. This questionnaire is recognized for its international reliability and validity, having been translated and validated in Iran by the Health Sciences Research Institute of the Academic Center for Education, Culture and Research (ACECR). The reliability of the questionnaire was assessed using Cronbach's alpha coefficient, which ranged from 77% to 95% across all dimensions, with the exception of the vitality dimension, which recorded a coefficient of 65% (20).

The questionnaire has been confirmed for its validity and reliability among the Iranian population. Research by Montazeri et al. (20) performed an internal consistency analysis, which found that all scales of the SF-36 questionnaire, apart from the happiness scale (Cronbach's alpha = 65%), exhibited reliability coefficients that ranged from 77% to 90%. Furthermore, the evaluation of convergent validity, which focused on testing the measurement hypotheses by analyzing the correlation of each question with the hypothesized scale, yielded positive findings. Every hypothesized correlation coefficient was favorable, with all values exceeding the recommended 4% threshold. In the research by Hedaari et al. (2007), the test-retest reliability of the questionnaire was evaluated with a two-week interval. The findings revealed reliability percentages of 91% in physical functioning, 75% in social functioning, 78% in role limitations due to emotional health, and 79% in fatigue or vitality.

Beck Anxiety Inventory: The Beck Anxiety Inventory was created in 1990 and is designed to assess the intensity of clinical anxiety symptoms in individuals. The Beck Anxiety Inventory (BAI) features 21 items, with participants selecting one of four available options for each item to denote their anxiety severity. The scoring for these options follows a four-point scale from 0 to 3 (21). Each question on the assessment outlines a typical symptom associated with anxiety, which encompasses both mental and physical manifestations of fear. Participants indicate their degree of distress related to these anxiety symptoms experienced in the past week in the adjacent column. The scoring system is categorized as follows: no score, a mild Beck score, a moderate Beck score of two, and a severe Beck score of three. Therefore, the range of anxiety scores was from zero to 63. A score ranging from 0 to 7 suggests that the individual being assessed experiences no anxiety. A score between 8 and 15 indicates mild anxiety, while a score from 16 to 25 reflects moderate anxiety. Scores ranging from 26 to 63 signify severe anxiety. Research indicates that this questionnaire demonstrates strong reliability, with an internal consistency coefficient (Cronbach's alpha) of 1.92. Additionally, its reliability assessed through the test-retest method over a one-week period is 0.75, and the correlation between questions ranges from 0.3 to 0.6 (22). Research conducted internationally has assessed five types of validity for this tool, including content validity, concurrent validity, simple validity, and factorial diagnostic validity. The findings consistently demonstrate the tool's high effectiveness in measuring anxiety (21). The validity and reliability assessed through a one-week test-retest method yield a coefficient of 0.75, while the item correlations vary between 0.30 and 0.76 (23).

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200
JFH

Standard Attention Deficit Hyperactivity Disorder Questionnaire: The SNAP-IV, or Attention Deficit Hyperactivity Disorder Questionnaire, was created by Swanson, Nolan, and Pelham in 1981 to assess attention deficit hyperactivity disorder in children and adolescents between the ages of 7 and 18. The questionnaire is comprised of 18 questions organized into two components and is based on a three-point Likert scale. It includes queries like, "I frequently do not pay attention to details or am careless with my homework, daily tasks, and other responsibilities," which are designed to measure attention deficit hyperactivity disorder in children. The research questionnaire utilized a five-point Likert scale for its rating system. To analyze the data, sum the scores assigned by the subjects based on the aforementioned statement. The lowest achievable score was 0, while the highest was 54. A score ranging from 0 to 18 indicates a low level of attention deficit hyperactivity disorder. A score between 18 and 36 reflects a moderate level of attention deficit hyperactivity disorder. A score greater than 36 reflects a high level of attention deficit hyperactivity disorder. According to the findings of Kiani and Hadianfar (2022), the questionnaire's content, face, and criterion validity were deemed suitable. The study also reported a Cronbach's alpha coefficient exceeding 0.7 for this questionnaire (24).

Upon receiving authorization from the university and coordinating with schools to obtain the necessary samples, consultations were conducted with parents and students to explain the parameters for creating a safe and stress-free environment. The initial step involved completing the attention deficit hyperactivity disorder questionnaire, which helped identify students diagnosed with the condition. These students were then randomly assigned to three separate groups. In the control group, no interventions were conducted throughout the study duration. Only the demographic information questionnaire, hyperactivity symptoms questionnaire, quality of life questionnaire, and anxiety questionnaire were administered both before and after the intervention, concurrently with the two intervention groups. From an ethical perspective, communication between the control and experimental groups was strictly prohibited during the study. At the study's conclusion, all instructional materials used with the experimental groups were made available to the control group as an educational package. The follow-up testing and data collection were designed to be conducted at intervals of three months.

Summary of parent-child interaction patterns training sessions: This program consists of eight sessions, each lasting 90 minutes. The eight intervention sessions are structured according to Eyberg's (2011) protocol for parent-child interaction patterns, with each session designed to last for 90 minutes.

Table 1. Summary description of parent-child interaction patterns training sessions, Eyberg (2011)

Sessions	Content
First	During this session, participants will have the opportunity to introduce themselves and the counselor, while also establishing the guidelines for attendance. Additionally, the session will focus on the concept of children's confrontational disobedience, exploring its contributing factors, the importance of emotional security for children, and the negative effects of overly strict control of their natural impulses. The discussion will also cover how early deprivation can influence a child's behavior later in life. A pre-test will be conducted as part of this session.

	Objective: To introduce the group members to each other, to form a relationship between the therapist and the subjects, to conduct a pre-test, to explain the concept of disobedience. **Assignment:** To observe the child in different situations and write down the signs of disobedience in them.
Second	During this session, mothers received guidance on influencing their child's behavior by adopting a slightly stricter yet more engaged approach. The importance of moderate control, consistent discipline, and, when appropriate, the use of punishment was discussed. **Objective**: To convey tips on parent-child interaction, tips on parenting stress and ways to manage it. **Assignment**: Collect information about the thoughts their child has when they are defiant (e.g., something bad might happen to my mother or I might never see my parents again. They don't love me)/ Discuss with parents the feelings and concerns that result from these thoughts (such as crying, anger, tantrums, etc.) Discuss the behavioral responses the child has to these counter-intuitive behaviors/ Ask parents to identify and characterize anxious thoughts, feelings, and behaviors in the child as homework and report them in the next session.
Third	This session focused on various behavioral issues in children, including non-adaptive behaviors like bedwetting and tantrums, and examined how parental involvement can help address these challenges. Participants were instructed on moderate, effective, and adaptable parenting techniques, highlighting the importance of engaging in constructive conversations with their children. **Objective:** Parenting styles and their positive and negative implications. **Assignment:** Identify the child's emotional responses such as crying, fussing/ Provide plenty of reassurance about the child's questions and concerns - Educate parents about how modifying these behaviors can impact the overall cycle of confrontational disobedience.
Fourth	In this session, mothers learned how to effectively respond to their child's needs and desires while also establishing and nurturing appropriate social relationships with them. The training emphasized the importance of avoiding ineffective interactions and ensuring clear communication of content. **Objective:** To state the factors affecting the child's psychosocial development and to clarify the concept of birth order / To teach the principles of behavior change (with an emphasis on reinforcement and ignoring) / To teach the principles of reinforcement/ Reinforcement can be material or non-material / It is better to be varied / It is better to provide it immediately after the desired behavior / The

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200
JFH

	rewarder is the child's favorite person. It is better to provide reinforcement by several people / Teach the principles of ignoring / Ignoring is used for behaviors that do not harm the child / Persistence and consistency in using this ignoring method will first increase the undesirable behavior and then decrease it / Ignoring should be done by everyone around the child and whenever the child engages in the undesirable behavior. **Assignment:** Reinforce appropriate behavior throughout the week
Fifth	This session emphasized the significance of interactions with friends and family, as well as connections with key individuals in one's life. It explored detrimental parenting practices, such as neglecting positive engagements with family and friends, as well as exhibiting aggression and strictness towards the child. In contrast, it is recommended that parents dedicate more time to engaging in play with their children and actively participate in these activities. **Objective**: To become familiar with the incorrect goals of children's behavior / Ignoring continues until the undesirable behavior decreases / It is better to reinforce independent behaviors while ignoring anxious behaviors Session 4 - Discussion and exchange of ideas with parents about applying the principles of behavior change and its results - Teaching the principles of behavior modification (with emphasis on token economy, shaping, and differential reinforcement) - Reinforcement training using the token economy method to gradually reduce the child's dependence on direct reinforcement - Shaping training: Reinforce behaviors that are similar and close to the desired behavior - Reinforce behaviors that are contrary to anxious and fearful behaviors. **Assignment:** Teach the correct ways to listen to children's words and concerns (without judgment or judgment during the week).
Sixth	In this session, the focus was on rule-based verbal and nonverbal interactions, examining the impact of nonverbal messages in social settings. Participants were taught how to communicate values, attitudes, and friendships effectively within their social networks. The session also stressed the importance of ethical considerations in all interactions. Objective: To familiarize parents with their negative behaviors and ways to deal with them. Assignment: shaping the child's behavior using punishment and reward techniques
Seventh	This session highlighted the influence of speech volume, gaze direction, and vocal tone on emotional responses. Participants were educated on how to address these challenges. Effective strategies included delivering clear messages, interpreting them accurately, actively listening to the child's expressions, and offering genuine reactions to meet the expectations of all involved.

	Objective: Effective ways to deal with children's behavior goals, teach how to encourage yourself and children, teach effective communication skills with children. **Assignment**: Describe enthusiasm Avoid critical expressions Avoid giving orders
Eighth	In this session, the sessions were summarized, ambiguities and questions were resolved, and a post-test was conducted.

Summary of the Transcranial Direct Current Stimulation Treatment Protocol

Sessions	Objective	Description
First	Preparation	Prior to initiating treatment, it is essential to properly position the patient for the procedure. This involves the placement of electrodes, the preparation of sensors, and the establishment of the necessary electrical connections.
Second	Current settings	After the initial preparation, adjustments to the electrical current are necessary. This includes the selection of current intensity, indicated in mill amperes, and the duration of the stimulation. These parameters should be set by the specialist therapist.
Third	Stimulation	At this stage, electrodes were attached to the patient's head using sensors. A weak, continuous electrical current was then applied to specific areas of the brain.
Fourth	Supervision and end of the course	During the application of the electrical current, the patient was monitored for any indications of symptoms or side effects. Once the session was finished, the specialist took the necessary steps to remove the electrodes.

Findings:

Descriptive statistical methods, including central and dispersion indices such as frequency, percentage, mean, and standard deviation, were employed to analyze and summarize the collected information. Inferential statistics were employed, utilizing multivariate analysis of covariance, univariate analysis of covariance, and Tukey's post hoc test to assess the data and examine the impact of intervention programs while controlling for pre-test effects. The analysis was conducted using SPSS version 21 software.

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200

JFH

Table 3: Descriptive information of groups in anxiety and quality of life variables

Group	Variable	Phase	Average	Standard deviation	Kurtosis	Skewness	Number
Control	Quality of life	Pre-test	۱۵۳,۶۷	۱۷,۸۰۳	۰,۲۹۶	-۱,۰۳۹	۱۵
		Post-test	۱۵٤,۸۰	۱۷,۶۲۰	۰,۸۹۷	۰,۷۹۷	۱۵
		Follow-up	۱۵٤,۷۳	۱۷,۵۰۳	۰,۹۵۵	۰,۸۷۵	۱۵
	Anxiety	Pre-test	۳۳,۰۷	٤,٤۱۵	-۰,۲۲٤	-۰,۲۶۷	۱۵
		Post-test	۳۲,۹۳	٤,٤۶٤	-۱,۰۲۸	۱,۲۳٤	۱۵
		Follow-up	۳۰,۹۳	٤,٤۶٤	۱,۰۲۸-	۱,۲۳٤	۱۵
Interaction analysis	Quality of life	Pre-test	۱٤۷,۷۳	۱۵,٤٤۳	۰,۳۰۶	-۰,۰۸۸	۱۵
		Post-test	۱۶۱,۳۳	۱۱,۵۳۷	-۰,٤۰۳	-۱,۵۲۲	۱۵
		Follow-up	۱۶۲,٤۰	۱۳,۰٤۸	-۰,۰۳٤	-۱,۱۱۸	۱۵
	Anxiety	Pre-test	۳۱,٤۷	۲,۲۰۰	-۰,۵۰۶	-۰,۱۲۷	۱۵
		Post-test	۲۳,۵۳	۳,۵٤۳	-۰,۶۱۱	-۰,۳۲۵	۱۵
		Follow-up	۲۱,۵۳	۳,۵٤۳	-۰,۶۱۱	-۰,۳۲۵	۱۵
Cranial electrotherapy stimulation	Quality of life	Pre-test	۱۵۹,۰۷	۱۸,۰۱۸	۰,۰۰۸	-۱,۰۷۱	۱۵
		Post-test	۱۶۵,۶۷	۱٤,٤۱۱	۰,۰۲۱	-۱,۸۹۳	۱۵
		Follow-up	۱۶۲,۲۷	۱٤,۶۵۱	۰,٤۹۲	-۰,۷۳۱	۱۵
	Anxiety	Pre-test	۲٤,۸۷	٤,۳۲٤	-۰,۳۸۵	-۰,۲۲۷	۱۵
		Post-test	۲۳,۲۰	٤,۸۵۸	-۰,۰۶۷	-۰,۱۵۱	۱۵
		Follow-up	۲۱,۲۰	٤,۸۵۸	-۰,۰۶۷	-۰,۱۵۱	۱۵

Table 3 presents the descriptive statistics for the anxiety and quality of life scores. The data indicates that the scores for both anxiety and quality of life among participants in the control group remain relatively consistent across the pre-test, post-test, and follow-up stages. It can be observed that during the pre-test phase, the scores among the groups show minimal variation. In the post-test phase, this variation in scores increases slightly, while in the follow-up phase, the difference in scores diminishes. The analysis reveals that the skewness and kurtosis values for the anxiety and quality of life variables across the four groups are contained within the range of (2, -2). This finding suggests that both variables are normally distributed with respect to skewness and kurtosis, indicating a symmetrical distribution. After analyzing the normality of the data distribution, the Kolmogorov-Smirnov test is applied to validate that the data conforms to a normal distribution.

Table 4. Results of Kolmogorov-Smirnov and Shapiro tests for normality

Variable	Phase	Group	Shapiro			Kolmogorov-Smirnov		
			Statistics	Statistics	Statistics	Statistics	Statistics	Statistics
Quality of life	Pre-test	Control	۰,۳۱۶	۱۵	۰,۹۳٤	۰,۲۰۰*	۱۵	۰,۱۵۳
		Interaction analysis	۰,۲۲۳	۱۵	۰,۹۲٤	۰,۱۲۷	۱۵	۰,۱۹۶

		Cranial electrotherapy stimulation	۰,۵۱۵	۱۵	۰,۹۴۹	۰,۲۰۰*	۱۵	۰,۱۴۸
	Post-test	Control	۰,۲۵۵	۱۵	۰,۹۲۸	۰,۲۰۰*	۱۵	۰,۱۳۹
		Interaction analysis	۰,۰۱۴	۱۵	۰,۸۴۳	۰,۰۲۰	۱۵	۰,۲۴۰
		Cranial electrotherapy stimulation	۰,۰۲۴	۱۵	۰,۸۶۰	۰,۰۵۹	۱۵	۰,۲۱۵
	Follow-up	Control	۰,۲۳۵	۱۵	۰,۹۲۶	۰,۲۰۰*	۱۵	۰,۱۳۷
		Interaction analysis	۰,۰۸۲	۱۵	۰,۸۹۶	۰,۱۱۵	۱۵	۰,۱۹۸
		Cranial electrotherapy stimulation	۰,۱۰۷	۱۵	۰,۹۰۳	۰,۲۰۰*	۱۵	۰,۱۷۹
Pre-test anxiety	Pre-test	Control	۰,۹۱۱	۱۵	۰,۹۷۴	۰,۲۰۰*	۱۵	۰,۱۱۰
		Interaction analysis	۰,۶۰۴	۱۵	۰,۹۵۵	۰,۲۰۰*	۱۵	۰,۱۵۷
		Cranial electrotherapy stimulation	۰,۱۷۱	۱۵	۰,۹۱۷	۰,۲۰۰*	۱۵	۰,۱۴۹
	Post-test	Control	۰,۱۵۳	۱۵	۰,۹۱۳	۰,۲۰۰*	۱۵	۰,۱۵۱
		Interaction analysis	۰,۲۲۸	۱۵	۰,۹۲۵	۰,۲۰۰*	۱۵	۰,۱۳۳
		Cranial electrotherapy stimulation	۰,۲۵۱	۱۵	۰,۹۲۸	۰,۰۹۹	۱۵	۰,۲۰۲
	Follow-up	Control	۰,۱۵۳	۱۵	۰,۹۱۳	۰,۲۰۰*	۱۵	۰,۱۵۱
		Interaction analysis	۰,۲۲۸	۱۵	۰,۹۲۵	۰,۲۰۰*	۱۵	۰,۱۳۳
		Cranial electrotherapy stimulation	۰,۲۵۱	۱۵	۰,۹۲۸	۰,۰۹۹	۱۵	۰,۲۰۲

Given that the significance level for the anxiety and quality of life variables across the four groups exceeds the established error threshold of 0.05, the results are deemed not significant. Therefore, it can be concluded that the score distribution is normal, allowing for the application of parametric statistical methods.

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200

JFH

Table 5. Results of Wilks Lambda test for anxiety scores and quality of life in groups

	Value	F	significance	Eta Squared
Pillay effect	۱/۶۰۲	۵/۶۱۴	۰/۰۰۱	۰/۵۳۴
Wilks Lambda	۰/۰۵۷	۷/۶۳۱	۰/۰۰۱	۰/۶۱۵
Follow-up Hotelling	۷/۰۲۲	۱۰/۶۸۸	۰/۰۰۱	۰/۷۰۱
Roy's Largest Root	۵/۸۰۴	۲۸/۴۴۱	۰/۰۰۱	۰/۸۵۳

The data presented in Table 5 indicates that the significance levels for all tests on anxiety and quality of life variables justify the implementation of multivariate analysis of variance, achieving significance at the 0.01 error level. This evidence points to a significant difference among the three groups concerning at least one of the dependent variables.

Table 6. Results of multivariate analysis of variance test for anxiety scores and quality of life in groups

	Dependent variable	Sum of squares	df	Mean squares	F	significance	Eta Squared
Group	Quality of life	۹۲۴/۱۸۳	۲	۳۰۸/۰۶۱	۲۲/۵۸۹	۰/۰۰۱	۰/۷۷۸
	Anxiety	۹۲/۳۱۷	۲	۳۰/۷۷۲	۳۸/۸۰۹	۰/۰۰۱	۰/۶۸۸
Error	Quality of life	۱۰۸۶۰/۰۰۱	۴۳	۱۹۳/۹۲۹			
	Anxiety	۹۵۲/۶۶۷	۴۳	۱۷/۰۱۲			
total	Quality of life	۱۵۵۱۹۴۷/۰۰۰	۴۵				
	Anxiety	۳۱۴۶۵/۰۰۰	۴۵				

Based on the data from Table 6, multivariate analysis of variance test to examine anxiety and quality of life and according to the F scores of the table (22.589 in the quality of life variable and 38.80 in the anxiety variable) and the significance level, it can be concluded that there is a significant difference in anxiety and quality of life among the three groups at the 0.01 level. In addition, it can be stated that there are significant differences in the average scores among the control, interaction analysis, and transcranial current stimulation groups. In the post-test evaluation of the quality of life variable, the transcranial current stimulation group scored 156.66, which was higher than the scores of the other groups. On the other hand, regarding the anxiety variable, this group recorded a score of 23.20, reflecting a lower anxiety level than the other groups in the post-test phase.

Table 7. Correlation of paired samples in quality of life and anxiety variables at post-test and follow-up.

Groups	Variable	Average difference	Standard deviation	T	Df	Significance
Control	Quality of life	۰/۰۶۷	۰/۷۰۴	۰/۳۶۷	۱۴	۰/۷۱۹
	Anxiety	۱/۸۶۷	۰/۳۵۲	۲۰/۵۴۶	۱۴	۰/۰۰۱
Interaction analysis	Quality of life	۱/۰۶۷	۲/۸۴۰	۱/۴۵۵	۱۴	۰/۱۶۸
	Anxiety	۱/۴۶۷	۰/۹۹۰	۵/۷۳۶	۱۴	۰/۰۰۱
Cranial electrotherapy stimulation	Quality of life	۳/۴۰۰	۷/۵۹۵	۱/۷۳۴	۱۴	۰/۱۰۵
	Anxiety	۱/۸۰۰	۰/۵۶۱	۱۲/۴۳۵	۱۴	۰/۰۰۱

The differences in quality of life and anxiety variables among groups at the post-test and follow-up stages are detailed in Table 7. The significance level demonstrates a significant variation in anxiety between the post-test and follow-up groups.

Discussion and Conclusion:

The effectiveness of group training in transactional behavior analysis therapy differs from that of transcranial direct electrical stimulation therapy regarding anxiety and quality of life in children diagnosed with attention deficit hyperactivity disorder. The research findings revealed a statistically significant difference in anxiety and quality of life across the three groups at the 0.01 level. This suggests that the average scores for the control group, the interactional behavior analysis group, and the transcranial direct electrical stimulation group were significantly distinct from each other. The findings indicate that there is a significant difference in anxiety and quality of life among the three groups at the 0.01 level. Furthermore, the average scores for the control group, interaction analysis group, and cranial electrotherapy stimulation group differ significantly from one another. During the post-test evaluation of quality of life, the transcranial electrical stimulation group recorded a score of 156.66, which was higher than that of the other groups. In the anxiety variable, the group receiving cranial electrotherapy stimulation achieved a post-test score of 23.20, which was lower than the scores of the other groups. This finding is consistent with the results of the research of Shareh and Bayani (19), Asgari et al. (25), Akbari et al. (26), Li et al. (27), Eschweiler et al. (28), and Silva et al. (29). The provided explanation indicates that behavior analysis theory places significant emphasis on humanistic concerns and generally views humans as possessing an inherent goodness. This theory is recognized as one of the applied frameworks in the field of counseling. One of the core principles of group work involves analyzing collective behavior, a process that is instrumental in driving significant changes in individuals' thoughts, emotions, and behaviors. At the beginning of therapy, increasing awareness of performance-related issues among participants and prompting them to reflect on these challenges can lead to meaningful life changes. This training proves to be beneficial for managing stress in both adolescents and adults, effectively preventing anxiety in younger individuals while

Family and health Quarterly, vol14, Issue 4, Winter 2024, ISSN: 2322-3065
https://sanad.iau.ir/Journal/fhj/Article/1205200
JFH

positively influencing their mental well-being. It is common for people to encounter anxiety throughout their lives, particularly when confronted with challenging and stressful circumstances. However, experiencing intense and persistent anxiety without an identifiable trigger is atypical. In the context of direct Cranial Electrotherapy Stimulation's effects on anxiety and quality of life for children with attention deficit hyperactivity disorder, it can be observed that this intervention modifies the firing rates of brain cells. This modification occurs through changes in neuronal excitability and adjustments to the membrane potential of surface neurons, which can lead to either depolarization or hyperpolarization. However, it is probable that anodic stimulation enhances brain excitability and restores the normal functioning of a child's nervous system. Furthermore, cranial electrotherapy utilizing direct anodic stimulation in the left dorsolateral prefrontal area appears to diminish and rectify the efficiency of the brain regions associated with anxiety-like and aggressive behaviors. Conversely, it appears that Interactional Behavior Analysis Therapy aids children in developing self-awareness and modifying their behaviors in everyday situations. This therapy enables them to recognize the automatic processes of their minds concerning past and future experiences, while also empowering them to manage their thoughts, emotions, and physical sensations through continuous awareness of the present moment. As a result, they attain a deeper sense of serenity, which plays a crucial role in fostering this tranquility in their children and mitigating the tensions that may cause anxiety. The research conducted by Bogels, Lehtonen, and Restifu (2010) corroborates the results of the current study. Additionally, Vandervoorde, Bogels, and Pingerberg (2012) demonstrated through their study that analyzing interactional behavior is effective in alleviating internalized issues, such as anxiety, in children diagnosed with attention deficit/hyperactivity disorder. Interactional analysis focuses on transforming parents' beliefs and attitudes towards ADHD, guiding them to recognize that inappropriate behaviors in these children are not intentional. This awareness can help reduce authoritarian, aggressive, or neglectful parenting practices. The symptoms associated with ADHD can influence multiple areas of functioning in children, especially in those who are of school age. Such children frequently demonstrate a deficiency in age-appropriate social skills and possess minimal awareness of the emotions, actions, and intentions of others. Thus, their emotional functioning is negatively affected, which restricts their ability to find enjoyment and engage with their surroundings. The overall quality of life for these children is diminished due to the array of social, emotional, psychological, and physical issues associated with this disorder. This approach further increases the probability of children improving their interactions with their parents. Moreover, it has both positive and negative aspects, largely due to the constrained time allocated for children with ADHD or other externalizing disorders. In conclusion, it can be stated that for these children, the intervention period is extended; however, the finite nature of this treatment is beneficial in managing costs and instilling hope in both the child and the parents who have felt powerless until now. One of the key limitations of this study is that the sample was limited to students with ADHD in Rasht, which hinders the ability to generalize the findings to other locations or to other types of disorders. This study determined the presence of attention deficit hyperactivity disorder solely based on a standardized questionnaire, and it is important to approach the research findings with caution. Researchers are encouraged to carry out comparable studies in various regions across the country and to explore additional mental health conditions, including autism and conduct disorder. Furthermore, it is recommended that a symptom checklist be utilized alongside the questionnaire to enable a specialist physician to select sample individuals, thereby enhancing the reliability of the results. It is recommended that, considering the

impact of transactional behavior analysis therapy and direct cranial electrotherapy stimulation therapy on anxiety and quality of life among first-year high school students with attention deficit hyperactivity disorder, greater emphasis should be placed on the application of these therapeutic approaches. Since many individuals with ADHD are affected by emotional and physiological symptoms, the findings presented imply that transcranial direct electrical stimulation therapy can play a role in further diminishing these symptoms. Thus, employing this therapy as an adjunct to psychological treatments, including interactional behavior analysis therapy, can facilitate more effective and expedited treatment progress.

References:

1. Jacobs H., Bockaert M., Bonte J., D'Haese M., Degrande J., Descamps L., Detaeye U., Goethals W., Janssens J., Matthys K., Muller L., Van de Walle H., Viane I., Vlieghe B., Grillet M., Asher R., Grillet B., De Bacquer D. The impact of a group-based multidisciplinary rehabilitation program on the quality of life in patients with fibromyalgia: Results from the QUALIFIBRO study. Journal of Clinical Rheumatology: Practical Reports on Rheumatic & Musculoskeletal Diseases, 2020; 26(8): 313–319 doi: 10.1097/RHU.0000000000001120
2. Aminde L.N., Takah N.F., Zapata-Diomedi B., Veerman J.L. Primary and secondary prevention interventions for cardiovascular disease in low-income and middle-income countries: a systematic review of economic evaluations. Cost effectiveness and resource allocation: C/E, 2018; 16: 22. https://doi.org/10.1186/s12962-018-0108-9
3. Zettin M., Bondesan C., Nada G., Varini M., Dimitri D. Transcranial Direct-Current Stimulation and Behavioral Training, a Promising Tool for a Tailor-Made Post-stroke Aphasia Rehabilitation: A Review. Frontiers in human neuroscience, 2021; 15: 742136. https://doi.org/10.3389/fnhum.2021.742136
4. Farahbakhsh K, Shariatmadar A., Salimi Bejstani H., Naarghi Ahmadi N. Effectiveness of teaching positive parent-child interaction program to parents of children with attention deficit hyperactivity disorder on reducing aggression. Psychology of exceptional people, 2021; 11(43): 63-86. doi: 10.22054/jpe.2021.56217.2235 (in persian)
5. Datta A, Bansal V, Diaz J, Patel J, Reato D, Bikson M. Gyri-precise head model of transcranial direct current stimulation: improved spatial focality using a ring electrode versus conventional rectangular pad. Brain Stimul, 2019; 2(4): 201.e–7.e. https://doi.org/10.1016/j.brs.2009.03.005.
6. Askari M., Falehkar As., Zarei A., Mirzahosseini F., Amani O. Comparing the effectiveness of treatment based on acceptance and commitment and transcranial electrical stimulation with alternating current on mood symptoms of depressed patients. Nursing Research, 2022; 13(4): 16-23.(in Persian)
7. Beasant B, Lee G, Vaughan V, Lotfaliany M, Hosking S. Health literacy and cardiovascular disease prevention: a systematic scoping review protocol. BMJ Open. 2022; 12(6): e054977. DOI: 10.1136/bmjopen-2021-054977.
8. Brown J.C., Gerhardt T.E., Kwon E. Risk Factors for Coronary Artery Disease. In StatPearls. StatPearls Publishing; 2022
9. Michielsen M.de Kruif J.Th. C.M. Comijs H.C. Brainmarker-I differentially predicts remission to various attention-deficit/hyperactivity disorder treatments: a discovery, transfer, and blinded validation study. Biological Psychiatry: Cognitive Neuroscience and Neuroimaging, 2019; 8(1): 52-60.

10. Dunst C.J., Trivette C.M., Hamby D.W. Meta-analysis of family-centered help giving practices research. Mental retardation and developmental disabilities research reviews, 2017; 13(4): 370–378. https://doi.org/10.1002/mrdd.20176
11. Lee D.H., Yang M., Keum N., Giovannucci E.L., Sun Q., Chavarro J.E. Mushroom Consumption and Risk of Total and Site-Specific Cancer in Two Large U.S. Prospective Cohorts. Cancer prevention research (Philadelphia, Pa.), 2019; 12(8): 517–526. https://doi.org/10.1158/1940-6207.CAPR-19-0101
12. Faundez V., De Toma I., Bardoni B., Bartesaghi R., Nizetic D., de la Torre R., et al. Translating molecular advances in Down syndrome and Fragile X syndrome into therapies. Eur. Neuropsychopharmacol, 2021; 28: 675–690. 10.1016/j.euroneuro.2018.03.006
13. Zuppardo L., Serrano F., Pirrone C., Rodriguez-Fuentes A. More than Words: Anxiety, Self-Esteem, and Behavioral Problems in Children and Adolescents with Dyslexia. Learning Disability Quarterly, 2023; 46(2): 77-91.
14. Wittenberg E., Goldsmith J.V., Beltran E. Attention-deficit hyperactivity disorder traits are a more important predictor of internalising problems than autistic traits. Scientific Reports, 2022; 13(1): 31.
15. Hughes M Graham J. Association of parent-rated sleep disturbances with attention-deficit/hyperactivity disorder symptoms: 9-year follow-up of a population-based cohort study. Journal of the American Academy of Child & Adolescent Psychiatry, 2018; 62(2): 244-252.
16. Galenkamp V. Napadow R. Edwards N. The relationship between quantitative sensory testing (qst), mindfulness, fatigue, and pain in fibromyalgia, The Journal of Pain, 2018; 19(3): 35- 48.
17. Lefaucheur J.P., Antal A., Ayache S.S., Benninger D.H., Brunelin J., Cogiamanian F., Paulus W. Evidence-based guidelines on the therapeutic use of transcranial direct current stimulation (tDCS). Clinical Neurophysiology, 2017; 128(1): 56-92.
18. Murphy K. R. Comparing the transfer effects of three neurocognitive training protocols in children with attention-deficit/hyperactivity disorder: a single-case experimental design. Behavior Change, 2017; 40(1): 11-29.
19. Plazier M., Ost J., Stassijns G., De Ridder D., Vanneste S. Systematic review of telehealth interventions for the treatment of sleep problems in children and adolescents. Journal of Behavioral Education, 2018; 29(2): 222-245.
20. Li K, Papademetris X, Tucker DM. BrainK for structural image processing: creating electrical models of the human head. Comput Intell Neurosci. 2016, https://doi.org/10.1155/2016/1349851
21. Datta A, Minhas P, Paulus W, Kuo M-F, et al. Comparing cortical plasticity induced by conventional and high-definition 4 × 1 ring tDCS: a neurophysiological study. Brain Stimulat 2013, 6(4):644–8. https://doi.org/10.1016/j.brs.2012.09.010
22. López-Alonso V, Cheeran B, Río-Rodríguez D, Fernández-del-Olmo M. Inter-individual variability in response to non-invasive brain stimulation paradigms. Brain Stimulat, 2014; 7(3):372–80. https://doi.org/10.1016/j.brs.2014.02.004
23. Wagner T, Fregni F, Fecteau S, Grodzinsky A, Zahn M, Pascual-Leone A. Transcranial direct current stimulation: a computer-based human model study. Neuroimage, 2017; 35(3): 1113–24. https://doi.org/10.1016/j.neuroimage.2007.01.027
24. Datta A, Zhou X, Su Y, Parra LC, Bikson M. Validation of finite element model of transcranial electrical stimulation using scalp potentials: implications for clinical dose. J Neural Eng, 2013; 10(3):036018. https://doi.org/10.1088/1741-2560/10/3/036018
25. Share H, Bayani M. Comparing the effectiveness of transcranial electrical stimulation (TDCS) and cognitive behavioral therapy (CBT) on craving, mood and smoking addiction. Journal of Principles of Mental Health, 2022; 4(11): 117-99. doi: 10.22038/jfmh.2022.37864.2612(in Persian)

26. Datta A, Baker JM, Bikson M, Fridriksson J. Individualized model predicts brain current flow during transcranial direct-current stimulation treatment in responsive stroke patient. Brain Stimul, 2021; 4(3):169–74. https://doi.org/10.1016/j.brs.2010.11.001
27. Opitz A, Paulus W, Will S, Antunes A, Thielscher A. Determinants of the electric field during transcranial direct current stimulation. Neuroimage, 2015; 109:140–50. https://doi.org/10.1016/j.neuroimage.2015.01.033
28. Salman A, Turovets S, Malony A, Eriksen J, Tucker D. Computational modeling of human head conductivity. Computational Science – ICCS 2005. Lecture Notes in Computer Science. 3514. Berlin, Heidelberg: Springer, 2015: 631–8.
29. Turovets SI, Poolman P, Salman A, Malony AD, Tucker DM. Conductivity analysis for high-resolution EEG. BioMedical Engineering and Informatics, 2018 BMEI 2008 International Conference on Los Alamitos: IEEE Computer Society, 2018: 386–93.
30. Fernández-Corazza M, Beltrachini L, von Ellenrieder N, Muravchik CH. Analysis of parametric estimation of head tissue conductivities using electrical impedance tomography. Biomed Signal Process Control, 2013, 8(6):830–7. https://doi.org/10.1016/j.bspc.2013.08.003
31. Fernández-Corazza M. Electrical Impedance Tomography Signal Processing for the Study of Brain Activity. PhD Thesis, National University of La Plata; 2015.
32. Gonçalves SI, de Munck JC, Verbunt JPA, Bijma F, Heethaar RM, da Silva FL. In vivo measurement of the brain and skul resistivities using an EIT-based method and realistic models for the head. IEEE Trans Biomed Eng, 2013; 50(6):754–67. https://doi.org/10.1109/TBME.2003.812164