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The Effect of Music on Attention in Schizophrenia

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Abstract

***Background*:** This study has been carried out in order to investigate the effect of musical activities on attention of schizophrenic patients.
***Materials and Methods*:** Since April 2010, 55 patients from members of the Association of Schizophrenic Patients (Ahba) were screened using available sampling method. They randomly divided into two groups which were consisted of experimental group (30) and control group (25). The experimental group participated in 24 sessions of the music therapy, which were provided in the place of Ahba association in June and July of the same year. Data were collected using Stroop test, continuous performance test and Lezak letter cancellation test in pre-test and post-test stages.
***Results*:** In the experimental group, average scores of processing speed, before and after intervention had significant difference and music affected this group ($p< 0.05$) but no significant deference was observed between and within the groups in other variables.
***Conclusion*:** Music therapy can be effective on elevating of maintenance of attention in schizophrenic patients, but a considerable influence on this group needs more studies.

Introduction

Schizophrenia is a severe psychiatric disorder with complex and multifactorial etiology. Probably, no other chronic illness similarly debilitates functioning as schizophrenia. An important component of schizophrenia involves disfunction in most of the cognitive domains [1], which is regarded as the core aspect of schizophrenia with strong influences on therapeutic results [2]. Training can improve some of the cognitive impairments. In fact, cognitive rehabilitation is a structured series of therapeutic activities, designed to restore one's ability of thinking, judgement and decision making. Among such activities music and art can be considered cognitive rehabilitation interventions [3]. Evidences prove that music can be effective in the production and regeneration of neurons and plasticity [4]. Also, due to the alteration of the steroids' level in the auditory circuits as well as emotional circuits and emotional system, it can be effective on spatial perception and cognitive functions [5, 6]. Form and consistent structure of music can improve health in psychotic patients and can be useful in psychio-social rehabilitation of people suffering from chronic and acute illnesses [6].

It can also enhance the quality of their life [7, 8]. The underlying rationale is that each cognitive training program progressively becomes more difficult and engages the participant in activities in which there is coordination between motor activities and cognitive short and long term strategies. This coordination plays an important role in maintaining cognitive skills in old ages. Naturally, the participant receiving music instruction feels motivated to achieve better coordination both due to the inherent pleasure of training as well as the acquired self respect for performing it proficiently. Therefore, music instruction is expected to be essential key to engage and maintain attention and memory systems during life [1]. On the other hand, one of the main difficulties with cognitive training interventions is the difficulty of applying them to everyday situations [9]. However musical activities are so engaging that people can do them even after the therapy session is finished [10].

Given the above, the music seems to be a special protocol to obtain good therapeutic results in therapeutic environments. It seems, on one hand, that the subject is active and several of his functions including cognition and movement are stimulated, on the other hand this therapy method is considered as a game and pleasure [11]. Regarding the fact that cognitive variables in schizophrenia do not become worse during pathological increase, the aim of this research is to study possible effects of music therapy program on attention of these patients

Materials and Methods

The type of this intervention was clinical trial aimed at studying the effect of musical activities on attention of patients suffering from schizophrenia. Since April 2010 in coordination with the Secretary and the social Worker of the Association of schizophrenic patients (Ahba) 55 patients were screened using available sampling method and were randomly divided into two groups of experimental (N=30) and control (N=25). Entry criteria

included: confirmation of a schizophrenia diagnosis made by a psychiatrist, the age range of 20-45, being in the chronic phase of disease (at least 2 years past the beginning of the illness), no symptoms of motor impairment (hand function, balance in sitting and standing position), deafness, blindness, mental retardation or any amputation of upper and lower limbs. Criteria of dismissal from the study were included exacerbation of symptoms during the experiment, lack of cooperation of patient and occurrence of epileptic attacks. Moreover, subjects' informed permissions to participate in the course had been provided as ethical considerations. Attention tests were taken during a session from all of the clients in the rooms of the association. Subsequently in the last week of April the experimental group participated in music therapy sessions provided every other day from 10 am to 11 am. The Designed Music therapy activities were consisted of singing, playing music therapy instruments and performing specific movements coordinated with music.

Activities were led by a music therapist and two music therapy assistants, experienced in working with psychotic adult patients and children with special needs. The process was as follows:

1) The first 5-6 minutes were spent working on gross motor skills and simultaneously, coordination between eyes, hands and legs were practiced. 2) Then subjects began singing together from texts. By the progress of sessions, subjects had to sing poems according to rhythm without using the text. Poems had been designed based on music therapist's experience ranging from simple to complex and necessary changes were implanted according to the occupational therapists instructions. In this section in addition to memory strengthening, advancement of social skills, intergroup communications and adhering to group rules were also followed. 3) Thereafter, subjects listened to music and had a discussion. In this section in order to control the level of arousal in subjects, they practised music with a low tone for a short time. 4) From the 4th session forward subjects performed group movements which became gradually more complex. 5) Instrument playing and use of musical instruments began with the 4th session with the intent to strengthen different types of memory and increase accuracy and concentration. Additionally, gentle movements and harmony of eyes and hands were considered. After passing 5 more sessions and assuring that subjects gained control over musical instruments, at the end of every session some group movements, designed by the research team, were performed.

These movements had to be done simultaneously with playing instruments. It is necessary to say that instruments of music therapy are special instruments largely used for therapeutic purposes. In this project the team used following instruments: daghak, choobak, maraca, skin tambourine, tambourine, finger cymbal, kairo, castanet, handled bell and timpani. After passing 24 sessions all participants were tested again in one session in late July.

The project data were collected by a researcher made questionnaire (including personal, medical and psychiatric information as well as non-medical treatments) and evaluating equipments of patients' attention. In order to assess the validity of the questionnaire content, a survey was conducted on 10 psychiatrists and the content ratio was 90%. Evaluating equipments included Stroop test, continuous performance test and letter cancellation test. Subject in the Stroop test was given three cards. Several points with green, red, blue and yellow color were put on the first card and subject was asked to name the colors. In the second card several words were printed in green, blue, yellow and red colors and the subject had to name the colors regardless of the word itself. In the third card, the green, red, blue and yellow words are printed with colors other than color of the word itself and subject has to tell names of the colors regardless of the meaning of the words. Error and the time required for reading each card were recorded [12].

On the continuous performance test some stimulants in the form of one number beside an image were shown randomly and subject was required to, in the case of observing the target, (the sameness of image and number on two following screens) push a button. Eventually, final results were gathered as variables: 1) the number of commission errors (the response of the subject to stimulants other than the target). 2) The number of omission errors (the number of target subject missed and did not have correct response. 3) Time of response (the time between producing stimulant and the response of subject). 4) The number of correct detection [12].

Letter cancellation test also had a paper on which a number of letters were irregularly placed next to each other. Subject had to draw a line around the special letter or letters, according to instruction. The number of errors and the time of the task completion were recorded [12]. Data were analyzed with the software SPSS-17. Data had a significance level of $p \leq 0.05$

Results

Participants were between 21 and 48 age group. Average age of the experimental group was 35.72±7.92 and in the control group was 35.15±9.17. Education level of the individuals was between secondary school and graduate school. 17 men and 8 women participated in the experimental group and 18 men and 8 women took part in the control group. Scales of descriptive statistics about age, gender and educations are represented in tables 1 to 3.

In order to compare samples' average, with regard to distribution pattern of data according to Kolmogorov-Smirnov test, pair *t*-tests and independent *t*-tests were used in time study of all tests. Wilcoxon's Signed- Rank test and Mann-Whitney *U* test are used for other variables as well. Non-parametric tests are shown also in table 5. It is considered that in congruent variables of the Stroop test with increase of response speed (from 1209.59 to 114.23), the number of correct response has been fixed in the experimental group, while with a very little increase in response speed, in the control group, the number of correct response has decreased (from 46.15 to 44.96).

That is, quick response in the control group has been equal to more errors.

In incongruent variable of the same test, significant increase of response speed in experimental group (from 1257.10 to 43.76) and (p=0.007), has elevated the number of correct response (from 41.5 to 43.76). Although the increase of the correct responses in control group is more than experimental group (from 42.08 to 45.13), this same little increase is justifiable in comparison with the significant response speed of the experimental group (p=0.007). So we can conclude that music within experimental group has increased the response speed and the number of correct response in Stroop test but this enhancement between two groups is not significant. In lezak letter cancellation test quicker responding of control group (from 220.30 to 294.95) in comparison with experimental group (from 232.8 to 226.52) has led to more errors (from 39 to 79 in control group in comparison with 12 to 16 in experimental group).

The conclusion could be that music has enhanced attention rate in the experimental group, however, the increase is not significant. In lezak letters cancellation, due to faster responding of the control group (from 220.30 to 194.95) in comparison with experimental group (from 232.8 to 226.52), more errors has been made (from 39 to 79 in control group in comparison with 12 to 16 in experimental group).

The result could be that music has enhanced the attention scale of the test in experimental group but not significantly. In Continuous Performance Test (CPT) while the response speed of the control group increased (from 442.4 to 417.14), the number of correct responses also increased (from 147.46 to 148.48) and times of omission error (from 1.12 to 1.00) and commission errors (from 1.142 to 1.00) have reduced. In the experimental group the speed of response also increased (from 458.62 to 446) but the number of correct responses did not changed. Moreover, times of omission and commission errors have had a little increase in number (from 62 to 67 in omission error and from 1.00 to 1.08 in commission error), that is, experimental group has shown a poorer performance than control group, which is likewise not significant. Altogether, it could be deduced that the average of processing speed and the number of correct responses of the Stroop test in experimental group is different from average of these scores in control group, however it is not significant. In the experimental group the average of processing speed has had significant difference, before and after intervening, and music has been effective on this group (p=0.007).

In Lezak test's error, despite improve of the outcome of experimental group, nevertheless, a significant difference is not seen. In the same test administering speed of control group, after test was more than experimental group, still no significant difference existed. In CPT test also not any significance observed. However, the performance of the control group was better which will be referred to in discussion.

Table 1. Demographic variables of age

People / Group	Number	Age (yr) (Mean±SD)	Min	Max
Case	48	35.72±7.929	21	48
Control	l47	35.15±9.177	23	47

Table 2. The frequency of education

Education	Intervention N(%)	Control N(%)
Secondary school	2(8)	3(11.5)
High school	4(16)	5(19.2)
Diploma	13(52)	12(46.2)
Post diploma	4(16)	1(3.8)
Bachelor	2(8)	5(19.2)
Master	2(8)	3(11.5)

Table 3. The frequency of sex

Sex	Intervention N(%)	Control N(%)
Male	17(68)	18(69.2)
Female	8(32)	8(30.8)

Table 4. Comparison of time in STROOP, CPT and Lezak before and after intervention

Variable	Before intervention (Mean±SD)		After intervention (Mean±SD)		p-Value within groups		p-Value between groups	
	Intervention	Control	Intervention	Control	Intervention	Control	Before	After
STROOP: Reaction time of congruent variable	1209.59±197.236	1068.00± 183.602	1145.23± 175.766	1062.70± 159.779	0.058	0.847	0.065	0.106
STROOP: Reaction time of non-congruent variable	1257.10 ±203.716	1143.43± 203.633	1146.48 ±180.006	1112.13± 181.930	0.007	0.280	0.164	0.533
CPT: Reaction time	458.62±58.417	442.04± 75.855	446.00± 53.129	417.14 ±57.421	0.24	0.094	0.401	0.087
Lezak Time	232.08 ±77.695	220.30± 81.967	226.52± 73.488	194.95± 64.981	0.573	0.124	0.878	0.139

Table 5 . Comparison of correct response in STROOP, correct detection, omission and commission error in CPT and error in Lezak before and after intervention

Variable	Before intervention (Mean±SD)		After intervention (Mean±SD)		*p*-Value within groups		*p*-Value between groups	
	Intervention	Control	Intervention	Control	Intervention	Control	Before	After
STROOP: Correct response of congruent variable	45.77±3.829	46.15±2.378	45.77±5.291	44.96±9.305	0.969	0.527	0.829	0.544
STROOP: Correct response of non-congruent variable	41.05±11745	42.08±9.130	43.76±9.643	45.13±5.084	0.450	0.064	0.803	0.615
CPT: Correct detection	148.38±2.568	147.46±2.718	148.25±2.270	148.48±1.289	0.924	0.085	0.072	0.680
CPT: Omission error	62±1.096	1.12±1.702	67±1.204	1.00±1.000	0.915	0.119	0.392	0.924
CPT: Commission error	1.00±2.064	1.42±1.767	1.08±1.717	1.00±1.000	0.001	0.201	0.067	0.458
Lezak: Error	12±6000	39±1.196	16±473	70±2.677	0.713	0.593	0.263	0.757

Discussion

The results of the study indicated that music is effective in processing speed and causes it to increase. However, no significant difference was observed in the other variables. With regard to findings above, results of the research can be represented in two separated themes.

Music can be effective on cognitive functions including attention. Rhythm, tone, melody and intensity difference of musical sounds influence functions of attention (especially specific attention to sonic characteristics of the stimulus) and spatial orientation by frontal-parietal web [13]. Furthermore, Musical activities can causes activities in the area of the external dorsal prefrontal cortex [14], which is considered one of the crucial areas of trauma [15]. Music instruction increases the activity of gamma wave and as a result causes improvement of attention, memory, integration of objects and multi-sensory [16]. Therapeutic mechanisms in music stimulate complex cognitive, sensory and motor procedures and convert them into non-musical and behavioural functions in brain [17]. In music therapy one forcibly improves his auditory skills because he is forced to move in a special manner with music, inflict a blow or sing a song. Harmonizing with music needs full attention to its pitch contour. And the more one uses these auditory nerve pathways the more nerve terminals and new synapses are made. In other words, long time sensory stimulation increases brain synapses, resulting ultimately in high level sensory perception [18].

Moreover, in music we encounter a phenomenon, named cross-model plasticity, in which cortical areas prevented from normal auditory and visual stimulations begin to processing the data of the healthy senses. Multisensory integration increases neuronic responses to multiple stimuli. Therefore, we will have multifaceted appearance of cortical. In music instruction there must be an interaction between perception of produced sound and motor programs for playing musical instruments. So primary cortex which seemingly responded to a modality now has to be more complex [19]. One of the findings observed in this research was an increase in speed of doing the Lezak test in post-test of the control group combined with more errors. The reason probably is that enhancement in attention range due to music, have made subjects of the experimental group perform the test with more intelligence and pause.

As mentioned before, despite the influence of musical intervention on the experimental group and the difference of the averages, there were not any differences to observe. This phenomenon can be studied from several points of view. First, fatigue factor can be referred to. In this research, although tests above were done with a few minutes break, waiting of these people might have been effective on their scores. Similar to this phenomenon has been seen in Thaut research that after musical intervention no change was seen and the author notes the very point as one of effective factors.

Next point involves the awareness of subjects about research. Due to ethical reasons, the research team was obligated to make subjects aware of the process of the project. Han states that subjects showed the tendency towards improvement but results were not significant and researcher state that it is due to awareness of people [20]. The other point is musical talent which returns to musical crude ability (not learned). Although, formal music instructions improve tests of musical talent, it is not clear that this relation is due to genetic or direct effect of music lessons [21]. Therefore, to study better the structural and functional differences due to influence of music on cognition, it is necessary to evaluate one's enthusiasm and talent with a precision instrument [22]. In the present project interest in music was evaluated merely by the fact that subjects were willing to take part in the study and no other special method was used.

The next factor is the issue of mood and arousal both of which influence cognition [23]. Every musical or non-musical stimulus or great pleaser (like a cup of coffee or a small present) which elevates the mood and arousal improves cognitive abilities [24]. Furthermore, arousal level naturally goes through a cycle during the day, which makes the difference to the cognitive abilities. By going through the day, young people show the increase in arousal and improvement in cognitive abilities, while older people will have a decrease in arousal and cognition. When the alteration of the mood and arousal before and after music are measured and fixed, cognitive advantages of listening to a happy and light music is reduced or omitted. Regarding that the age range of people in this project was relatively extended (20 to 45) the research team inevitably used also pleasant non-musical stimuli like snacks between exercises to prevent

the fluctuations of arousal. So, it cannot be confidently said that lack of significant difference in the averages has been due to ineffectiveness of the intervention or attempt to maintain the level of the arousal has lessened this influence. Alterations of the mood also impair the performance of cognition. Cognitive tasks are better performed when one has a high mood. Negative or exhausted mood, in contrast, reduces the performance of the cognition. As mentioned before this research is not blind and subjects were aware of its process. Because the subjects in experimental group were aware of ending of the term, which based on their declarations has had an attraction, it is possible that their moods have reduced. On the contrary, being already in the waiting list of the program, the control group has experienced a higher mood during the test.

Researches which study the relationship between emotion and cognition claim that some tests are more sensitive to emotional stats than other. Such influences probably occur when the test presented is challenging. In this research the characteristic of the tests may cause such results. The progress of the tests may have a role in the results. Although we did not encounter any special points in any sources about how our considered tests are to be carried out, the possibility of this influence exists. This can justify the results of the control group in CPT test.

The other issue is mental effort. A large percentage of schizophrenic patients during neuropsychological evaluations do not exhibit enough mental effort. Almost one third of the changes seen in the results of such tests can be justified by insufficient mental efforts [25]. The team in this project did not use any special behavioural tests to evaluate mental effort, which is recommended to be considered in future studies. However, just one study had used the tests of evaluation of the mental effort before neuropsychological tests. When we encounter complex intervention including music, to cover all of the impairing variables is a great challenge [26].

The research team in this project had covering all of the possible cases before completing evaluations. Regarding the relationship between depression and cognitive deficits, the Beck depression test was used before intervention in order to screen the intensity of depression of individuals and there was no significant difference.

It should be noted that not all researches acknowledge the association between depression and cognitive deficits in schizophrenia [27]. Although some studies have indicated the relationship between negative symptoms and cognitive deficits, this relationship is not permanent [28]. Thus, negative symptoms have a small contribution in cognitive deficits. In the above research, due to time limitation as well as insignificant effect of negative symptoms on cognition, the team refrained from taking respective tests which might account for some of the problems and might have caused discrepancies in outcome of the study. Another reason could be the fact that there were no follow-up with the subjects to see whether or not the effects had become more evident.

In order to see statistically significant difference, the group size was not big enough and more admission was not possible due to lack of resources and the time. Accordingly, such researches need some follow-up periods to determine whether the effect of treatment had been continuous or not.

According to what was said cognitive rehabilitation based on music can make some changes to performance of brain. Since attention deficit in schizophrenia has an extended range and has a crucial role in life and social results of these patients, it is critical to determine effective factors on attention like music and provide more targeted and influential treatments.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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