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Executive Functions among Substance-Induced Psychotic Patients in Jordan: A Clinical Neuropsychological Study

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ABSTRACT

This study aims at exploring the executive functions among substance/medication-induced psychotic patients. The sample consists of two groups, a clinical group composed of 27 patients diagnosed with substance/medication-induced psychotic patients. The sample is obtained from the National Center Hospital for Mental Health located in Fuhais and from Hashem Fakhouri's psychiatric private clinic located in Amman during a 9-month period and is screened for entry in the study. The sample also consists of a comparative group made up from of 27 healthy adults, matched the clinical group in some demographic variables. The following neuropsychological tests are used to measure executive functioning; Stroop Color Word Test, Wisconsin Card Sorting Test, and Executive Function Index. The results show that the substance/medication-induced psychotic patients have had poor performance on tasks that requires shifting response, inhibition, resistance, to interference, planning, changing strategies, learning from trials, learning from feedback, impulse control, empathy, organization and motivational drive. This group has performed significantly worse on executive functions tests than the comparative group.

Keywords: Executive functions; drug induced psychosis; clinical neuropsychology.

Introduction

In the last years, people have become more aware and educated about mental and psychological disorders. Due to this increased awareness, there is a rise in the number of patients (in-patients and out-patients) visiting psychologists and psychiatrists in public and private clinics and hospitals, for a variety of reasons. One such reason is "psychotic features", when a person's perceptions, thoughts or emotions are distorted so severely that contact is lost with external reality.

Psychosis

Eugen Bleuler (1857-1939), a Swiss psychiatrist, was the first one to use the word schizophrenia, a word we still use today. The word comes from the Greek roots of "sxizo" meaning " to split or crack" and " phren" meaning " mind". Together the two words describe disturbance in thought and emotion and an inward orientation away (split) from external reality. People usually confuse this split with multiple personality disorder, which is a major misconception. Bleuler mentioned in his writings a subtitle called "the group of schizophrenias" because he believed that this disorder wasn't a single diagnostic entity. From there, with time, diagnostic criteria were created for other psychotic disorders, and nowadays the significant loss of contact with reality is referred to as psychosis (Butcher, Mineka, & Hooley, 2013).

According to DSM-V, there are other psychotic disorders including: Delusional Disorder, Schizophreniform Disorder, Schizoaffective Disorder, and Substance/Medication-Induced Psychotic Disorder. Differentiating between them is beyond the scope of this study since the sample of this study consists of Substance/Medication-Induced Psychotic patients, which has relatively little amount of studies examining this type of patients.

In general, psychotic symptoms are divided in two groups, positive symptoms and negative symptoms and patients

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could exhibit both of them during the course of their disorder (Butcher, et al., 2013).

Positive symptoms are the ones that describe a distortion in a normal repertoire of behavior and experience such as delusions, hallucinations, and persistently bizarre behaviors, as for the negative symptoms, they are the ones that describe an absence/deficit of behaviors that are normally exist such as flat affect, alogia, avolition and anhedonia (Butcher, et al., 2013, Andreasen, & Olsen, 1982).

Dopamine plays a big role in psychotic disorders such as schizophrenia, and it is believed that levels of dopamine is behind the psychotic features of substance/medication-induced psychosis. Drugs can lead to brain malfunctions because they lead to dopamine flooding in the brain, and this happens while, for example, using Flakka drug (very popular in the United States) which is a synthetic substance (Crespi, 2016).

There are other drugs that can cause psychosis such as cannabis. Cannabis is associated with an increased risk of psychosis if used on daily basis for long term (Kumar, & Clark, 2016). Also alcohol can lead to psychotic symptoms, usually the hallucinations are auditory and the voices are usually reproachful, and threatening, Some patients report that the voices are pleasant and nondisruptive. Amphetamines such as Khat have similar positive symptoms as in paranoid schizophrenia but amphetamine-induced psychosis lacks the affective flattening and alogia of schizophrenia. Paranoid delusions are very common in cocaine-induced psychosis in addition to auditory hallucinations, it is also common for cocaine users to have a sensation of bugs crawling under their skin. Hallucinogens such as LSD, opiods, phencyclidine, sedative, and anxiolytic, such as barbiturate and benzodiazepines, can also lead to prolonged hallucinations and delusion, barbiturates causing them more often than benzodiazepines (Sadock, Sadock, & Ruiz, 2015).

Neuropsychological assessment

Clinical neuropsychology is an applied field of psychology that is concerned with the behavioral manifestation of brain dysfunction through neuropsychological examination. Neuropsychological assessment can be used to diagnose psychiatrical and neurological symptoms. Neuropsychological tools are used to assess higher cortical functions and neuropsychological syndromes such as visuospatial abilities, visual or auditory memory, speech, language, executive functions and many other abilities that are controlled by the brain. Obtaining detailed information about the patient's cognitive status and personality characteristics helps planning a decent intervention, so patient's capacities and limitation and how much these capabilities and limitations are affecting patient's quality of life must be understood. (Lezak, 1995).

In this study, executive functioning will be tested; including inhibition of automatic response, planning, changing strategies and problem solving, which are all needed for daily normal functioning. Several studies identified the connection between schizophrenia and other psychotic disorders and impairments in several cognitive domains and executive functions, as will be discussed.

Research on neuropsychological assessment of individuals who use substances is limited due to several reasons, One of the major reasons being the difficulty in obtaining the patient sample, since most psychoactive drugs are illegal to use and possess, in addition to this, patients usually use more than one substance, which would affect results in a significant matter. Cannabis, cocaine and heroin are only examples of many drugs that can lead to deficits in executive functions in addition to deficits in attention, psychomotor tasks, short-term memory, long-term memory, verbal memory, visual memory, visuospatial processing speed, and other deficits (Sadock, et al., 2015).

Psychotic symptoms can occur not only due to street drugs intake, but they can also be induced by prescribed medication, as concluded by McGahan, Wojslaw, Prasad, & Blankenship (2016) while observing a man who was prescribed Propranlol with other medication for uncontrolled hypertension, the man presented with hallucinations and delusions that resolved after substituting Propranolol.

The same symptoms were demonstrated in another study conducted by Chawla, Rao, & Sagar (2006) based on their case study of a 32 year old man who was prescribed oral Baclofen 10 mg twice daily for relief of muscular spasms secondary to tetanus. After 4 weeks of using the prescribed medication, the patient presented auditory hallucinations in addition to persecutory and referential delusion that took a week to disappear after discontinuing Baclofen. In order to confirm their conclusion that this was a result of the medication, the patient took Baclofen again and within 2 day of

restarting Baclofen, the patient re-experienced psychotic symptoms. Chawla, et al. (2006) concluded that psychotic symptoms can reoccur after reusing the drug, even if the positive symptoms had disappeared after treatment. Dore, & Sweeting, (2016) conclusion agrees with this conclusion, since they also concluded, that even after stopping drug intake and getting rid of the psychotic symptoms, psychotic symptoms reoccur if starting drug intake again. The conclusion was based on their one case study of a woman with borderline personality traits who developed severe drug dependence that let to substance/medication-induced psychosis for high-dose of Crystalline Methamphetamine. The woman suffered from paranoid schizophrenia like symptoms that occurred repeatedly after high-dose use of Crystalline Methamphetamine.

There are few studies that have focused on substance/medication-induced psychotic patients from a neuropsychological perspective, two studies are discussed below.

A single case study conducted by Crespi (2016) focused on Flakka-Induced Prolonged Psychosis. Flakka (alpha-pyrrolidinovalerophenone) is a new vey cheap street drug, which led to symptoms such as psychomotor agitation, slowing of cognition, delusions, disorganized hallucinations and other altered mental states in addition to bizarre and illogical behaviors after only one use of this drug. After a multiple-day treatment using benzodiazepines and antipsychotics, the patient still suffered from psychomotor agitation and slowing of cognition even though the patient was oriented.

Another study conducted by Yamamuro, kimoto, Lida, Kishimoto, Nakanishi et al., (2016) examined the effect of methamphetamine on prefrontal cortical activity and inhibitory control in patients of drug-induced psychosis using Stroop test. Methamphetamine is chemically similar to amphetamine and it is a strong central nervous system stimulant and extremely addictive. The sample consisted of two groups, a clinical group of 14 drug-induced psychotic patients caused by methamphetamine and a control group of 21 participants. The results showed that the clinical group performed worse on Stroop test than the control group, this indicates that Methamphetamine-induced psychotic patients have higher levels of impulsivity.

Most of the studies that were concerned with neuropsychological functioning of psychotic disorders, and aimed at studying different psychotic disorders other than substance/medication-induced psychosis, these studied as follow.

1. Studies which focused on neuropsychological functioning of psychotic patients.

Sánchez-Torres, Elosúa, Lorente-Omeñaca, Moreno-Izco, & Cuesta, (2015) conducted a comparative study of the working memory multi-component model in psychosis and healthy controls, they compared 21 psychotic patients with 21 healthy controls using subtests of the Wechsler Adult Inteligence Scale (WAIS) (Vocabulary, Similarities, and Block Design), subtests of the Wechsler Memory scale (WMS) (Digit Span, and Spatial Span), Baddeley's dual task, Trail Making Test, N-Back, and the Stroop test. Patients with psychotic disorder showed impairment in most of the working memory tests compared to the controls. Greater impairments were observed in the tasks that assess the phonological loop such as digit span, and shifting executive functioning such as Trail Making Test.

Leeson, Robbins, Franklin Harrison, Harrison, et al., (2009) examined the dissociation of long-term verbal memory and fronto-executive impairment in first-episode psychosis. The sample consisted of two groups, 97 healthy controls and 97 first episode psychotic patients, the majority of whom developed schizophrenia. Both groups were matched in IQ and sex and were compared using the Cambridge Automated Neuropsychological Test Battery to measure visuospatial working memory, planning, attentional set-shifting. Auditory Verbal Learning Task was also used to measure verbal memory. After comparing performance between the two groups on verbal learning and recall, visuospatial working memory, planning, and attentional set-shifting. The results showed that psychotic patients' performance was impaired in all these domains compared to the controls. Factor analysis showed, all variables except verbal memory retention loaded on a single factor, they concluded that deficits in psychotic patients may reflect a problem in prefrontal cortex information processing rather than specific impairment in different cognitive domains, however verbal memory retention impairments may have a different etiology.

2. Studies which focused on neuropsychological functioning of schizophrenic patients.

Dixit, & Hasan, (2016) wrote a review paper on Cognitive dysfunction in schizophrenia and schizophrenia spectrum disorder, using 96 empirical studies that were available on Pub Med database and Google Scholar which were conducted

from January 2005 to March 2015. All domains including attention, executive function, comprehension, learning and memory were impaired.

As for brain structural changes and neuropsychological impairments Nagashima, Inoue, Kitamura, Kiuchi, Kosaka, et al., (2012) studied structural changes and neuropsychological impairments in male polydipsic schizophrenia. The sample consisted of Japanese participants, 8 polydipsic schizophrenics , 8 non polydipsic schizophrenia, and 8 healthy controls. Participants' brain volumes were compared using Magnetic Resonance Imaging, as for the neuropsychological assessment; the Brief Assessment of Cognition in Schizophrenia was used to assess verbal memory, working memory, motor speed, verbal fluency, attention/ speed processing, and executive functions. Results show no differences between the two groups of schizophrenia with respect to the clinical characteristics, it also showed that schizophrenics have widespread brain volume reduction and have an overall neuropsychological impairment compared to the healthy controls. The polydipsic schizophrenic group performed worse than the non polydipsic schizophrenic.

Arguedas, Langson, & Stevenson (2012) also studied neuropsychological characteristics associated with olfactory hallucinations in schizophrenia (OH) , comparing them to auditory-verbal hallucinations in schizophrenia (AVHS) that had no life-time history of olfactory hallucinations. The sample consisted of three groups; 11 OH patients, 10 AVHS patients, and 18 healthy controls. The tests that were used are; The University of Pennsylvania Smell Identification Test, a battery of standardized tests of executive function , and socio—emotional tests which assess orbitofrontal cortex and amygdale function. Both group of patients generally performed more poorly than controls during the odor identification, socio-emotion tests, and executive function tests. There were differences between the two schizophrenic groups in orbitofrontal cortex functioning.

It is believed that sex plays a role in neuropsychological functioning, so Bozikas, Kosmidis, Peltekis, Giannakou, Niatoudis, et al., (2010) studied differences in cognition between male and female schizophrenic patients, since some researchers suggested that male schizophrenic patients are more impaired than females. The following set of tests were used, the Digit Span forward subtest of the WAIS and the Spatial Span forward subtest of the WMS to measure attention. The digit span backward subtest of the WAIS and the spatial span backwards subtest of the WMS were used to measure working memory, the Wisconsin Card Sorting Test (WCST) (number of completed categories and perseverative errors) was used to measure abstraction, the Stroop test and Trail-Making Test Part B to measure inhibition, the Design fluency Test and the Greek Verbal Fluency Test to measure fluency , the Greek Word List Learning Test based on the California Verbal Learning Test was used to measure verbal learning and memory, The Rey–Osterrieth Complex Figure Test was used to measure visual memory, and finally The Rey–Osterrieth Complex Figure Test and the Hooper Visual Organization were used to measure visuospatial skills and psychomotor speed. The sample consisted of 56 male schizophrenic patients, 38 female schizophrenic patients, 31 healthy male adults, and 31 healthy female adults. Results showed that schizophrenic patients were significantly impaired in all of the domains assessed with the exception of psychomotor speed. There were no significant differences between male and female patients on the tests with the exception of verbal learning and memory, where the female patients scored significantly better than the male patients. This difference however is typical and can be observed in healthy populations as well.

Schools, & Martin-Iverson, (2010) studied the effect of cannabis use on neuropsychological performance in healthy individuals and patients with schizophrenia. The sample consisted of three groups, 36 cannabis users who are not psychotic, 35 healthy non users, 22 cannabis users diagnosed with schizophrenia, and 49 non using schizophrenic patients. Both schizophrenic groups showed significantly poorer performance on Stroop test, letter- number sequencing, and spatial span subtests of the WMS, in addition to a poorer performance on WCST compared to non schizophrenic groups. There were no significant differences between the two schizophrenic groups on any of these tests.

Bozikas, Kosmidis, Kiosseoglou, & Karavatos (2006) examined neuropsychological profile of cognitive impaired patients with schizophrenia. The study included 2 matched groups, one of them consisted of 70 patients with schizophrenia and the other group consisted of 42 healthy control subjects matching the first group in age and sex. The following tests were used: WCST, Stroop test, and Trail-Making Test part B to measure executive function, Digit span

backward subtest of the WAIS and Spatial span backwards subtest of the WMS to measure verbal and non verbal working memory, Greek Word List Learning based on the California Verbal Learning Test to measure Verbal memory, The Rey-Osterrieth Complex Figure Test to measure Visual memory, immediate and delayed recall, and recognition, Design Fluency Test, and the Greek Verbal Fluency Test to measure Fluency, Digit Span forward subtest of the WAIS, and Spatial span forward from the WMS to measure Auditory and Visual Attention, The Rey-Osterrieth Complex Figure Test and the Hooper Visual Organization Test to measure Visuospatial abilities, and finally, Trail-Making Test part A was used to measure psychomotor speed. Patients with schizophrenia performed worse than the healthy control subjects on tests that measured executive functioning, working memory, verbal memory, non verbal memory, verbal fluency, visuospatial abilities and attention. The researchers concluded that patients with schizophrenia have widespread impairments which are manifested in a generalized brain dysfunction.

3. Studies which focused on neuropsychological functioning of psychotic disorders other than substance/medication-induced psychosis and schizophrenia.

Matsui, Yuuki, Koto, Takeuchi, Nishiyama, et al., (2007) studied schizotypal disorders and schizophrenia: A profile analysis of neuropsychological functioning in Japanese Patients. Their sample consisted of 3 groups of Japanese participants, 37 schizophrenic patients, 28 schizotypal patients, and 99 normal volunteers. Subtests from WAIS were used to assess working memory (Digit Span), spatial organization (Picture Completion and Block Design), Language (Vocabulary), Processing speed (Digit symbol), immediate and delayed recall were measured with the Logical Memory subtest of the WMS, in addition to Japanese version of a neuropsychological battery and a short version of WCST to assess executive functions, The Japanese Verbal Learning tests to assess verbal fluency, and Japanese letters similar to FAS test to assess letter fluency, and The Trail Making test to assess working memory. Impairment in verbal memory, language, and processing speed tasks were common in both clinical groups as for impairment in working memory, spatial organization, and executive function tasks were observed only in the schizophrenic group.

In conclusion, studies concluded that psychosis had a major impact on neuropsychological functioning, and different psychotic disorders have different neuropsychological deficits.

Problem Statement

This study aims at exploring the executive functions among substance/medication-induced psychotic patients, using three executive functions tests. The rational of the study lies in the following points: Firstly, substance/medication-induced psychosis is becoming a more problematic issue because of the increases in drug availability and intake as it reached in Jordan, by the statistics of the court of justice, to almost 173 kilograms of various drugs, which were destroyed this year by the Jordanian government.

Secondly, few studies shed the light on substance/medication-induced psychotic patients and even fewer addressed the neuropsychological functioning of substance/medication-induced psychotic patients.

Importance of the study

Only a small number of studies addressed neuropsychological characteristics of substance/medication-induced psychotic patients compared to other psychotic disorders such as schizophrenia. This study will help to further our understanding of the brain functions of substance/medication-induced psychotic patients. In addition to this, the popularity of synthetic cheap drugs has been increasing over the last few years, which are taken by different kinds of people with different educational, socioeconomically backgrounds in Jordan. Consequently, the results of this study may be beneficial to better understand how to manage, treat and rehabilitate the increasing numbers substance/medication-induced psychotic patients and educating their care givers. Also the results also may be helpful for educating populations who are exposed to drugs and who are at risk of developing substance/medication-induced psychosis through awareness campaigns.

Study Objectives

This study aims at exploring the executive functions among substance/medication-induced psychotic patients and compare their level of performance on executive functions tests to the healthy comparative group. These tests will

include Stroop test, WCST and Executive Function Index (EFI).

Research Questions

Study question:

Are there differences in Executive functioning between substance/medication-induced psychotic patients group and the healthy comparative group?

Definition of Terms

Substance/medication-induced psychosis

Substance/medication-induced psychosis is a psychotic disorder where the psychosis is attributed to the substance use. Substances can be a central nervous system depressants or it can be a central nervous system stimulants, such as cocaine, amphetamines, phencyclidine, cannabinoids, LSD, anticholinergic drugs and the clinical sample will be pre-diagnosed by professionals based on the criteria mention above from DSM-V (American Psychological Association, p.110).

Executive functions

Executive functioning include the capacity of successfully engaging in a purposeful and self-serving behavior independently. When executive functions are impaired, the person can't function independently since these impairments affect all aspects of behavior. If the person suffers from cognitive loss, he still can perform independently, constructively and productively in self-serving tasks if the executive functioning is still intact. Impairment in executive functioning can manifest itself in impulsivity, lack of self control, difficulty in monitoring performance, difficulty initiating behavior, difficulty in shifting attention and behavior, deterioration in personal hygiene, difficulty planning and carrying out a sequence of tasks. For the purpose of this study, Stroop test, WCST, and EFI will be used to measure executive functions.

Stroop test color word test (Trenerry, Crosson, Deboe, & Leber, 1989) is a test that produces a strong interference effect (the name of the color is printed in a different color), leads to difficulty in inhibition the automatic response (reading the word), to produce the acquired response which is a verbal response of the name of the ink color. This test requires a great deal of higher cognitive functions to deal with the conflict. Low scores on this tests can be explained by either slow response due to the cognitive conflict, failure of inhibiting automatic response, or failure of selective attention and concentration (failure to ignore distraction – words) (Trenerry, et al., 1989).

Wisconson Card Sorting Test (Heaton, 1981) is a test that was originally developed to assess abstract reasoning and shifting strategies in response to environment, nowadays it is widely used to measure executive functions such as planning, changing strategies, and maintaining problem solving strategy across different stimulus (Heaton, 1981). It also requires cognitive flexibility, organizing steps and elements to complete an intentional task or to achieve a goal, organized searching which requires the ability to understand the current circumstances, make choices by utilizing environmental feedback, good impulse control, and sustained attention (Groth-Marnat, 2000) and it is considered as a cross cultural test.

Executive Function Index which was developed by spinella (2005), is a self reporting index which was developed using samples from normal population. Five subscales derived through factor analysis: Empathy (EM), Strategic planning (SP), Organization (ORG), Impulse control (IC), and Motivational drive (MD). Spinella developed this index to be able to collect data from a big sample for the aims of his study.

Study limitations

There was a restriction in choosing the neuropsychological tools since only that standardized tests for Jordanian population were used and which in return plays big role in the results of this study, in addition to the tools, the substance which was used by the clinical group who developed substance/medication-induced psychosis also plays a role is the results of this study.

Methodology

This study aims to explore the executive functions among substance/medication-induced psychotic patients compared to the healthy group.

Study sample

Increasing numbers of substances related disorders can be explained by many reasons; biological processes play a big role in drug dependence. Tolerance can reduce some effects of the drugs which lead to taking higher dosages of those drugs which lead to higher risk of physical dependence, in addition to the fact that withdrawal symptoms usually motivate for further drug use. Psychological factors varies since different approaches have different theories explaining drug use, it could be a manifestation of oral regression, a result of disturbed ego functions, or a result of positive consequences, such as reducing pain, anxiety, depression, panic, anger, or a combination, in addition to drug-induced euphoria (Sadock, et al., 2015).

People resort to central nervous system depressants or stimulants to escape reality, as it can be seen in people from various social classes, specially people who have been through a traumatic experience. People may also begin taking drugs as a result of peer pressure. Some kinds of central nervous system depressants or stimulants may lead to hallucinations or delusions. These symptoms may result from intoxication, withdrawal from the drug, or a side effect of mixing substances (Bacon, Granholm, & Withers, 1998).

Social pressure, demographic variables, and war also play role in various substance related disorders (Sadock, et al., 2015).

Santor, Messervey, & Kusumakar, (2000) found in their study while focusing on school performance, sexual attitudes, and substance abuse in adolescent boys and girls through measuring peer pressure, popularity, and conformity and , that peer pressure and peer conformity adolescents were stronger predictors of risk behaviors.

Certain demographic characteristics usually are associated with certain psychological disorders, for example, as Al-Jbour, & Sammour, (2016) concluded, while studying depression, that Males were less depressed than females, also elderly people were less depressed than other age groups.

Demographic characteristics are considered as strong predictors of substance abuse, with gender, age, race, and socioeconomic status being most important. Mueser, Yarnold, Levinson, Singh, Bellack, & et. al., (1990) found that males abused each class of drugs more than females did, particularly alcohol and cannabis. Young patients were more prone to abuse stimulants (both cocaine and amphetamines) than other drugs. There was an interaction between race and different types of substance abuse. White patients were more likely to have abused alcohol or sedatives and less likely to have abused cannabis than black patients were. Within the sedative abusers, white patients were more likely to have abused barbiturates than blacks were, but not anxiolytics. Finally, patients with a lower socioeconomic status were more likely to have abused cannabis.

As for the socio- demographical characteristics, Lamptey, (2005) found in his study socio-demographical characteristics factors, such as large number of siblings in the family and crime, are positively related to substance abuse.

As for war, it effects the population who are suffering from different psychological disorders, for example posttraumatic stress disorder independently increases risk of marijuana and hard drug abuse/dependence (Kilpatrick, Acierno, Saunders, Resnick, Best, & et. al., 2000). War also effects soldiers, Seal, Cohen, Waldrop, Cohen, Maguen, & et. al., (2001-2010) studied substance use disorders in Iraq and Afghanistan veterans and they found that Post-deployment alcohol use disorder and drug use disorder diagnoses were more prevalent in subgroups of Iraq and Afghanistan veterans and were highly comorbid with PTSD and depression.

These reasons are beyond the scope of this study since the aim is to see what happens, from a neuropsychological perspective, to executive functions among patients who are diagnosed with substance/medication-induced psychosis.

The study sample consists of two groups, substance/medication-induced psychotic patients and healthy comparative group. A convenient clinical group of subjects was recruited and matched by a comparable healthy comparative group of individuals in demographical characteristics to resemble the clinical group.

The 31 subjects of the clinical group were assessed, 4 of which were excluded in this study because the data obtained from them wasn't reliable. The clinical group's age ranges from 18 to 57 years old, and they were pre diagnosed with Cannabis-induced psychosis or Joker-induced psychosis (Joker is a street name for a synthesized drug which consists of

CP 47, 479 drug, synthetic cannabis, and petroleum material), according to DSM-V criteria, by at least one psychiatrist. The clinical sample was obtained from the National Center Hospital for Mental Health located in Fuhais and from Hashem Fakhouri's psychiartical private clinic located in Amman during a 9-month period and were screened for entry in the study. At the time of the study, they were going under psychiatric treatment for at least one week.

Inclusion criteria were fulfillment of the DSM-V criteria for substance/medication-induced psychosis: (A) The hallucination and Delusion developed during or soon after substance intoxication or withdrawal or after exposure to a medication, and (B) the symptoms are not caused by any physical or other mental disorder.

Exclusion criteria were: (1) symptoms or signs of dementia, (2) head trauma (with loss of consciousness),(3) neurological disease, (4) use of any drugs or alcohol in the 7 days,(5) a previous diagnosis of schizophrenic disorder, and (6) duration of symptoms less than 2 weeks.

As for the 27 healthy subjects of the healthy comparative group, the range of their age began from 19 to 59 years old, healthy people were recruited from local companies and shops who have no history of psychiatric problems. The aforementioned group members were matched with the clinical group members in terms of demographic characteristics including gender, age, socio-economic status, and level of education.

A family history of psychosis or use of antipsychotic medication was a further exclusion criterion for the healthy comparative group, as was a personal history of psychosis or use of antipsychotic medication in the relatives.

Table 1 shows the demographic characteristics of both groups

Table 1 ***Characteristics of the study sample.***

	Clinical Group		**Comparative Group**	
Variable	N	%	N	%
Sex				
Male	23	85	23	85
Female	4	15	4	15
Variable	N	%	N	%
Level of education				
Primary school	7	26	7	26
Secondary school	11	41	11	41
High school	4	15	4	15
Higher education	5	18	5	18
Variable	N	%	N	%
Occupational Status				
Employed/ had a job	16	59	16	59
Unemployed	11	41	11	41
Variable	Age mean (SD)		Age mean(SD)	
Age	38(14.07)		37.21(14.08)	

Executive functions tests

1. Stroop Color Word test (Trenerry, et al., 1989): It is a timed task, two minutes or under, that consists of a paper with 112 (4 across, 28 down) color names (red, green, blur, tan) printed on. These color names are printed in incongruent colored ink, so no name is printed in its matching color, e. g., the word red is never printed in red ink. The participant is given 120 second to name as many correct ink colors as possible in the order that they were printed on the paper. Score is given based on the number of correct responses; number of items completed minus incorrect responses. Scores run from 0 to 112 points.

2. WCST (Heaton, 1981): This test consists of 4 stimulus cards that vary in form: crosses; circles, triangles, and stars, colors; red, blue, yellow, and green, and numbers; one, two, three, and four. These cards are placed in front of the subject from left to right where 1 is a red triangle, 2 is two green stars, 3 is three yellow crosses, 4 is four blue circles. Two decks of 64 response cards are given to the participant, one deck at a time. The participant would be asked to match each response card with the stimulus appropriate card while paying attention to the response, right/wrong, about the sorting principle from the examiner. After reaching 10 consecutive correct responses, a complete category, the principle of sorting is changed. The first sorting principle is color, shifts to form, and then finally it shifts to number, and the participant should be able to finish these category twice with 128 response cards. The number of completed categories will be measured with a minimum of 0 and maximum of 6 points. Perservative errors will also be counted, continuing to sort in a wrong principle and ignoring the feedback. Besides, the total number of errors were measured which is the sum of perservative errors and non-perservative errors.

3. EFI (Spinella, 2005): This task includes 27 items that cover five domains which are (i) EM, (ii) SP, (iii) ORG, (iv) IC, and (v) MD. The participant would be asked to rate sentences with "how much does this describe you" on a scale from 1-5, where 1 implies "not at all" and 5 represents "very strongly". Total score ranges between 27 to135 points. Cronbach alpha reliability coefficient was calculated, it was 0.78 for this index, which is within acceptable values. This index was translated by Al-Suuna' (2016) in his thesis while studying the difference in executive functions among depressed patients and a normal matching sample and the index is reliable (alpha= 0.53) and valid (Pearson correlation coefficient= 0.57) for using on Jordanian population.

Procedure

After getting the appropriate training on how to administer executive functions a tests, the tests were administered to a random sample of people who were similar in their characteristics to the targeted samples in clinical and healthy comparative groups to assure standardization of procedures. Assessment of the clinical group was completed after at least one week of undergoing pharmacological treatment.

All tests and tasks were administered to all subjects of the clinical group. Then, the matched healthy comparative group was recruited. All the tests and tasks were administered to all subjects of the healthy comparative group, after going through screening them for the characteristics stated earlier in the sample section.

Each participant was informed about the objective of the study before the administration of the tests and tasks. The tests were administered according to the instructions from their administrative manual. The test order of the tests and tasks was consistent across all participants in both groups.

The Design used in this study is the 2 matched group design. The collected data were administered and analyzed using the Statistical Package for the Social Sciences-V16 known as SPSS to derive descriptive statistical analysis and two-sample independent *t*-test analysis.

Results

Descriptive statistics

Table 2 shows some descriptive statistics, mean and standard deviation, for all tests that were administered for both groups, clinical and healthy comparative group.

Table 2 ***Mean (M) and Standard Deviation (SD) for Study Variables with N=27 in Each Group***

	Clinical Group		Comparative Group	
Variable	**M**	**SD**	**M**	**SD**
Stroop Test	45.7	20.12	100.85	11.08

	Clinical Group		Comparative Group	
Variable	**M**	**SD**	**M**	**SD**
WCST Categories	4.37	1.96	6	0
WCST Errors [a]	46.85	29.18	11.81	2.89
WCST perservative Errors [a]	37.44	30.28	1.59	1.62
EFI	85.59	18.35	104.19	12.59
EM- EFI	19.63	4.65	24.67	3.8
SP- EFI	20.11	6.25	23.33	2.94
ORG- EFI	15.96	4.22	19.15	4.64
IC- EFI	14.74	4.35	18.59	3.8
MD- EFI	11.78	3.71	16.3	3.71

Note. WCST= Wisconsin Card Sorting Test; EFI= Executive Function Index; EM= Empathy; SP= Strategic Planning; ORG= Organization; IC= Impulse Control; MD= Motivational Drive.

[a] Lower scores reflect better performance

Answer to research question

Are there differences in Executive functioning between substance/medication -induced psychotic patients and the healthy comparative group?

Two-sample independent *t*-test was performed to investigate if there are significant differences between the clinical and the healthy comparative group. Tables 3, 4 and 5 show the results of *t*-test.

Table 3 t-test results on the Stroop Color Naming test.

Variable	*P*	DF	*T*
Stroop	**.00****	**52**	**12.474**

** Significant at $p< 0.001$

The two-sample independent *t*-test analysis indicates that there are significant statistical differences between the two groups' performance, on Stroop test subtests at the $p<0.001$, where $t =12.464$. By going back to table 2, the clinical group had significantly worse performance on this test than the healthy comparative group since clinical group's mean is lower than the healthy comparative group

Table 4 t-test results on the WCST

Variable	*P*	DF	*T*
WCST Categories	.00**	52	4.339
Total Errors	.00**	52	4.352
Perservative Errors	.00**	52	2.422

** Significant at $p< 0.001$

The two-sample independent *t*-test analysis indicates that there are significant statistical differences between the two groups' performance, on WCST at the $p<0.001$, where $t = 4.339$ for number of categories. The clinical group produced less categories. As for the total number of errors, $t = 4.352$. By going back to table 2, the clinical group had significantly worse performance on this test than the healthy comparative group since clinical group's mean is higher which means they produced more errors than the healthy comparative group.

As for number perseverative errors, $t = 2.422$. By going back to table 2, the clinical group had significantly worse performance on this test than the healthy comparative group, since clinical group's mean is higher than the healthy comparative group. The clinical group produced more perseverative errors

Table 5 t-test results on the EFI.

Variable	*P*	DF	*T*
Total	.00**	52	4.339
EM	.00**	52	4.352
SP	.02*	52	2.422
ORG	.01*	52	2.634
IC	.00**	52	3.461
MD	.00**	52	4.33

Note. EM= Empathy; SP= Strategic Planning; ORG= Organization; IC= Impulse Control; MD= Motivational Drive. *Significant at $p< 0.02$

** Significant at $p< 0.001$

The two-sample independent *t*-test analysis indicates that there are significant statistical differences between the two groups' performance, on EFI at the $p<0.02$, where $t = 4.339$ for total score, $t = 4.352$ for EM domain, $t = 2.422$ for SP domain, $t = 2.634$ for ORG domain, $t = 3.461$ for IC domain, and $t = 4.330$ for MD domain. By going back to table 2, the clinical group had significantly worse performance on this test than the healthy comparative group since clinical group's mean is lower than the healthy comparative group.

Discussion of results

"Are there differences in Executive functioning between substance/medication-induced psychotic patients and the healthy comparative group?"

The results showed that substance/medication-induced psychotic patients' executive functioning is impaired compared to the healthy group. This impairment was evident through their performance on Stroop color word test, WCST, and EFI.

The impaired performance on the Stroop test and WCST can be explained by the requirements of these tests.

Stroop test requires the ability to shift response, inhibition, and resistance to interference, which seems that substance/medication-induced psychotic patients have problems to do such tests, this mainly because they have frontal lobe (FL) dysfunction so they become more sensitive to interference which leads to inability to inhabit the inappropriate response. In addition to that, observations during the Stroop test may also help explain the low scores on it. The clinical group participants took a longer time, up to 10 seconds, to move from one column to the next. Also the clinical group were slower in naming the colors, this observation are in agreement with what Crespi, (2016) concluded that Flakka-Induced Psychosis suffer from slowing cognition.

Impairment on WCST can be explained by the fact that these patients have FL dysfunction, which can be predicted from the WCST requirements, such as planning, changing strategies, shifting response, learning from trials, and learning from feedback during the test. Because of the impairment in these abilities, patients produced more perseverative errors, total errors, and less number of complete categories. In addition to this, the test requires, but does not measure, short term memory which helps in maintaining a complete set. Impaired performance can also be explained by the fact that the clinical group is sensitive to distractibility.

Slow responses in WCST can be due to malfunctioning of the motor area in the dominant hemisphere or by lack of motivation or by inability to initiate behavior in which the FL plays a major role. Low scores on WCST can also be explained by loss of abstraction (inability to sort according to a category) which is one of the FL functions.

Results on the Strategic Planning subtest of the EFI are consistent with the results of WCST test. Furthermore, the results on the Impulse Control subtest of the EFI are consistent with the results of the Stroop test. In addition to performance on Strategic Planning and Impulse Control, the index assessed Empathy, Organization, and Motivational Drive are also impaired.

EM items measure a concern of other people's well-being, willingness to help others. SP items measure tendencies to plan ahead, use of strategies to make a decision, problem solving. ORG measure the ability to organize behavior, to multitask, to perform sequencing. IC measure ability to inhibit inappropriate behavior and tendencies of taking risks. MD measure levels of behavioral drive and activity level in addition to level interest in novelty.

The impairment in performance of the clinical group on the EFI can be explained by prefrontal lobe cortex dysfunction which is responsible for controlling impulse, planning, problem solving, changing strategies, empathy, organization, and motivational drive.

These functions are required in everyday normal functioning, and are required when we are processing information on daily basis, this in turn explains why the clinical patients were impaired in the previous tests.

Clinical group's mean on these domains were worse than the mean of Spinella's (2005) for the non clinical sample, which leads to a conclusion that, supported by performance on the rest of the tests that were assessed in this study, the clinical group have problems in the FL functions.

These results are in agreement with the conclusion of the following studies; Dixit, et al. (2016), Arguedas , et al. (2012), Nagashima, et al. (2012), Leeson, et al. (2009) , and Matsui, et al. (2007), concluded that executive functioning was impaired in psychotic patients comparing to healthy controls.

The following studies used Stroop test; Sánchez-Torres, et al. (2015), Schools, et al. (2010), and Bozikas, et al. (2006), who concluded that psychotic patients performed worse on Stroop test than healthy controls,

Yamamuro, et al. (2016) also concluded that patients performed worse on this test and had higher levels of impulsivity comparing to controls. The results of the current study are in agreement with the conclusions of these studies.

As for studies that used WCST such as; , Bozikas, et al. (2010), Schools, et al. (2010), and Bozikas, et al. (2006), who also concluded that psychotic patients performed worse on WCST than healthy controls, and the results of this study are in agreement with their conclusions.

Conclusion and Recommendation

The results of this study showed that the substance/medication-induced psychotic patients were impaired in executive functions tests. The results also seems indicate that those patients have FL dysfunction and in particular prefrontal lobe cortex.

Further research should be addressing substance/medication-induced psychosis using newer neuropsychological tools. Assessing other brain functions which were not included in this study. Using a broader study sample diagnosed with substance-induced psychosis that is caused by substances other than Joker and Cannabis, will lead to more observations and a more accurate result. Finally it may be beneficial to study the effects of the demographical variables of substance/medication-induced psychotic patients on their neuropsychological functioning.

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الوظائف التنفيذية لدى عينة من المرضى المصابين بالذهان الناجم عن تعاطي المواد في الاردن: دراسة من وجهة نظر علم النفس العصبي الاكلينيكي

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ملخص

تهدف هذه الدراسة إلى التعرف على الوظائف التنفيذية لدى عينة تكونت من (27) مريضًا مشخصين بالذهان الناتج عن تعاطي المواد وتم مقارنة نتائجهم بنتائج مجموعه متماثلة لهم بالخصائص الديموغرافية من الأشخاص الأسوياء، تم الحصول على العينة الاكلينيكية من مرضى مستشفى المركز الوطني للصحة النفسية في الفحيص وعيادة دكتور هاشم فاخوري الخاصة في عمان. وتم استخدام اختبار ستروب واختبار وسكونسون لتصنيف البطاقات وقائمة الوظائف التنفيذية لقياس الوظائف التنفيذية. أشارت نتائج الدراسة إلى أن أداء المرضى المصابين بالذهان الناجم عن تعاطي المواد على الاختبارات التي تقيس الوظائف التنفيذية كان يعاني من عجز مقارنة مع نتائج المجموعة السوية. حيث أظهرت عينة المرضى في المهارات والمهام التي تتطلب تغير الاستجابة و الكف والمقاومة للتداخل و التخطيط وتغير الاستراتيجيات والتعلم من المحاولة والخطأ والتغذية الراجعة والتحكم بالاندفاعية والتقمص العاطفي و لتنظيم والدافعية.

الكلمات الدالة: الوظائف التنفيذية، الذهان المرتبط بتعاطي المواد، علم النفس العصبي الاكلينيكي.

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