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Factors Affecting the Cognitive Domains Dysfunction among Adolescent with Substance Use Disorder

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ABSTRACT

Background: Substance abuse is a significant public health concern with numerous clinical implications. Cognitive dysfunctions were amongst the most significant health issues connected with teenage substance usage.

Aim: This study aimed to detect the factors affecting the cognitive domains dysfunction among adolescent with substance use disorder. **Patients and methods:** Among one hundred substance abusers and forty controls, a case-control comparison was undertaken. Several historical variables and the Addiction Severity Index, the Wisconsin card sorting test, and the socioeconomic scale are explored. **Results:** Parent's education affecting all executive functions domains in a protective way. Grow up in an urban area has a significant positive effect on executive functions generally and specifically in our patients. Schooling has a protective effect against executive function deterioration in adolescents with substance use. The severity of substance use is proportionate to the severity of executive function deterioration. The socioeconomic status has a protective effect on the executive dysfunction of adolescent with substance use disorder.

Conclusion: Smoking, cannabis and alcohol, are the most widely used substances by adolescents. Multiple executive function domain affection and poly substances are the common role not the reverse in adolescents.

Keyword: Executive function, Wisconsin Card Sorting.

INTRODUCTION

Adolescence is a vulnerable developmental stage in which major changes occur in young bodies, brains, and environmental socialisation, which may increase sensitivity to substance abuse and psychiatric associated morbidities [(1)]. Numerous studies have demonstrated that the majority of adult substance and alcohol abusers had their first experience with these substances as teens [(2)]. During youth and young adulthood, substance abuse, including alcohol, illegal substances, and prescription medications, is most likely to begin. Seventy percent of high school seniors have tried alcohol, fifty percent have used an illegal substance, and more than twenty percent have abused prescription medicines for nonmedical purposes [(3)]. Cognitive functions and skills are among the most researched and well known mental processes. It is recognised that complex and crucially essential features have a connected structure, individual variation that is highly affected by genetic variances, and a scientific basis rooted in brain function. According to a number of studies, substance use disorders are related with deficits on a diversity of cognitive tests that are believed to assess many domains of cognitive ability. Yet, it is recognised that several subdomains of cognition are interconnected and success in any of these is typically correlated with overall cognitive capacity [(4)].

Previous therapy studies of substance abusers with reduced executive functioning have significant shortcomings. They have mostly examined the acute and subacute consequences of chronic alcohol and drug abuse, and long-term recovery studies often do not need a 14-day drug-free interval before baseline testing [(5)]. Several studies have small sample sizes and concentrate on individuals with a single major addiction [(6)].This study aimed to determine the factors that influence cognitive domain failure in teenagers with substance use disorder.

PATIENTS AND METHODS

This case-control research was carried out on treatment- seeking patients in Faculty of Medicine, Suez Canal University Hospital, Addiction Centers and Clinics of Suez Canal area. It included 100 subjects as sample size with 40 healthy control subjects recruited from apparently healthy blood donors.

Patient and control group were chosen by convenience method to both themselves and their parents, where the control group were healthy blood donor in the regional area. Patients who were attending the Psychiatric Facilities, Faculty of Medicine, Suez Canal University Hospital and the Psychiatry Hospitals' Clinics of Suez Canal regional area were evaluated and recruited consecutively after fulfilling the inclusion criteria in the period from October 2019 to December 2021.

Inclusion criteria: Patients aged from 13 to19 years of both gender, patients with substance use disorders that were diagnosed corresponding to the criteria of the International Classification of Diseases (ICD-10) and patients after the detoxification.

Exclusion criteria: Patients with neurodevelopmental disorder, patients with epilepsy, severe head trauma and neurologic deficits, patients with sensory defect as hearing or visual defect, patients who were intoxicated or had withdrawal symptom and patients with other co-morbid mental disorders.

Evaluation was done by the attendant psychiatrist, and verification of the diagnosis did via senior psychiatrist.

After inclusion in the study, the proband underwent laboratory assessment for toxicology screening, and psychometric assessment included Teen-addiction severity index, socioeconomic status scale and the WCST. Every study participant was subjected to: Full comprehensive psychiatric sheet included socio demographic data. Complete physical and neurological

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examination to exclude neurological or organic co-morbidities. Structured psychiatric interview done through applying The Mini-International Neuropsychiatric Interview v.5 (M.I.N.I. kid) was developed by **Sheehan *et al.*** [7] and we used the Arabic translation developed by **Tripathi *et al.*** [8].

Urine toxicology screening before & after detoxification. Psychometric Assessment: Teen-Addiction Severity Index by **Kaminar *et al.*** [9]: It was an objective, systematic, face-to-face interview with the assessor having the chance to provide comments, confidence ratings (showing whether the material may be misinterpreted) and ratings for severity (indicating how severe the assessor believes was the need for treatment or counseling). Before treating a teenager's drug abuse-related difficulties, provide basic information about the adolescent. Analyzed Problems: Substance usage, school attendance, employment support, Family relationships, peer/social relationships, legal status (participation in a criminal justice programme), psychiatric status and list of contacts for further information. It was interpreted by the official office for translation, and it will be translated again before a pilot study is performed on a sample of adolescents under the supervision of research supervisors. Socioeconomic scale developed by **El-Gilany** and colleagues [10]. The socioeconomic scoring for this study's sample comprised of domain scores for occupation, education, house sanitation, family belongings, family, economics, and health care.

Test of Card Sorting in Wisconsin: This test was originally designed to evaluate abstract thinking skills and the capacity to adapt cognitive methods to change environmental conditions. As such, The WCST can be seen as a test of executive function since it requires the participant to form and stick to an effective strategy for solving problems despite changes in the input conditions. The metric was sensitive to developmental and maturational alterations [11]. Individuals between the ages of 6.5 and 89 can take the test, which relies on a variety of cognitive functions such as attention, working memory, and visual processing and is used to assess proficiency in abstract reasoning and the flexibility to adapt one's approach to solve problems as new information becomes available. The test also necessitates planning, organised searching, using environmental feedback to shift cognitive sets, directing behaviour towards a goal, and mnemonics. The following domains were given following WCST Scoring: The number of right responses and whole number of errors, number of trials provided, total number of errors, and number of categories completed: The number of categories (each sequence of 10 consecutive correct matches to the criterion sorting principle) that the customer successfully completed during the examination. The range of possible scores is between 0 and 6. Increase in the number of completed categories demonstrates the test's overall effectiveness. **Trials to finish 1st Category:** The whole number of trials necessary to successfully complete the 1st category indicates the original conceptualization prior to the need for a set shift. **Numbers of perseverative answers and errors:** The increase in these numbers represents the inability to recognise new opportunities (i.e., decreased flexibility) density of perseverative errors in proportion to total test performance. The growth in non-perseverative mistakes is a result of inadequate problem-solving strategies. **Failure to sustain set:** It occurs when the client makes 5 or more consecutive accurate responses, but then makes an error before finishing the category correctly. It demonstrates the capacity for sustained focus.

Ethical approval: informed consent was granted by the Medical Ethical Committee of Suez Canal University (number 3684, 30 August 2018). Permission from the patient or the patient's legal guardian was obtained at the start of the investigation based on the nature of the research. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

The statistical analysis

Data analysis was performed using the Excel programme for figures and statistical package for social science version 16 (SPSS Inc., Chicago, IL). K-S (Kolmogorov-Smirnov) test was performed to determine the normality of data distribution. Only meaningful data proved to be nonparametric. The one-way analysis of variance (ANOVA) is utilised to investigate group differences in age, years of schooling, and other variables, as appropriate for further research. Using X^2 analysis, gender-based group variances are studied. Using a multivariate analysis of covariance (MANCOVA) with years of education and economic subscales as factors, we analysed group variances in subscale score distributions. Analyses of group variances on the WCST using univariate ANOVAs. $P \leq 0.05$ was considered significant.

RESULTS

According to Table 1, there was a substantial variation in parental education levels among the patient and control groups (p=0.031 and p=0.001, respectively). It was statistically significant (P=0.009) that the average daily income of the sick group was greater than that of the control group. As for patients' socioeconomic status, they averaged lower than the controls (p=0.034). Patients were mostly employed (79.0%). In contrast, every single member of the "control group" in this study was a student. There was a substantial distinction (p= 0.039) amongst the 2 groups. The majority of patients (39%) and the majority of the control group (35%) belonged to the middle and high socioeconomic levels, respectively. Whereas, 35% of patients' group and 17.5% of the control group belonged to the low socioeconomic levels. Statistically, there was a substantial distinction between the 2 groups (p=0.034). More than half (63%) of patients came from rural areas, while the majority (65%) of the control group lived in big cities. The statistically substantial distinction among the 2 groups was p=0.047.

Table (1): Socio-demographic variables

		Patients' N=100	Controls N=40	p Value
		Mean ± SD	Mean ± SD	
Age (Years)		17±1	17±2	0.043*
Education years		6±3	10±2	
Father Education		9±3	10±2	0.031*
Mother Education		9±3	13±2	0.001**
Income Daily		72±51	39±10	0.009*
Socio-Economic Status		2±1	3±1	0.041*
Gender	**Males**	94%	82.50%	0.012
	Females	6%	17.50%	
Marital	**Single**	98%	100.00%	
	Married	2%	0.00%	
Religion	**Moslem**	97%	97.50%	
	Christian	3%	2.50%	
Residency	**Rural**	63%	35.00%	0.047*
	Urban	37%	65.00%	
Hobbies	**No Hobbies**	97%	20.00%	0.05*
	Have Hobbies	3%	80.00%	
Occupation	**Student**	21%	100.00%	0.039*
	Working	79%	0.00%	
Socio-Economic Scale	**Very Low**	19%	0.00%	0.034*
	Low	35%	17.50%	
	Middle	39%	47.50%	
	High	7%	35.00%	

Table (2) showed that there were direct positive correlations between either mono- or poly-substance uses on the multi WCST domains without specification.

Table (2): Correlation between different substances use and WCST domains

		Number of categories completed	Trials to first category	Failure to maintain set	Total number of errors	No. of perseverative errors	No. of erseverative responses	No. of non-perseverative errors
Cannabis use disorder	**Pearson**	.294**	.195	-.171	-.098	-.102	.149	-.083
	Sig	.003	.051	.090	.333	.313	.140	.412
Alcohol use disorder	**Pearson**	.217*	.051	-.021	-.068	-.175	.029	.065
	Sig	.030	.612	.837	.502	.081	.771	.519
Opioids use disorder	**Pearson**	.182	-.082	-.036	-.151	-.096	-.053	-.199*
	Sig	.070	.416	.725	.135	.341	.601	.047
Benzodiazepines Use disorder	**Pearson**	.194	-.219*	-.358**	-.388	-.386	-.271**	-.350
	Sig	.053	.029	.000	.101	.210	.006	.199
Inhalants use disorder	**Pearson**	.241*	-.633	-.578	-.567	-.558	-.567	-.519
	Sig	.016	.063	.059	.071	.074	.091	.182

Table (3) showed that use of alcohol, opioids, cannabis, inhalants and benzodiazepines predicted an increase of 7.5, 5.3, 3.3, 2.5 and 1.5 respectively of the score of number of total number of errors. Using both alcohol + cannabis, alcohol + inhalants and opioids + cannabis predicted an increase of 9.2, 8.4 and 7.7 points respectively in the total number of errors. Drugs of abuse can explain 80.6% of the variance of the total number of errors.

Table (3): Effect of different substances use on the total number of errors

	Unstandardized Coefficients		Standardized Coefficients	t	P value
	B	Std. Error	Beta		
(Constant)	64.193	4.090		27.918	.000
Cannabis use disorder	-3.338	1.208	-.010	.279	.01**
Alcohol use disorder	-7.521	.857	-.021	-.608	.041*
Opioids use disorder	-5.354	.973	-.047	-1.391	.010*
Benzodiazepines Use disorder	-1.586	1.090	-.052	-1.455	.010**
Inhalants use disorder	-2.534	1.723	-.069	-1.471	.04*
Alcohol + Cannabis	9.212	.771	.041	1.119	.001**
Opioid + Cannabis	7.731	1.081	.056	1.099	.003**
Alcohol + Inhalants	8.432	1.432	.19	1.161	.000**
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.856	.804	.806	4.585	

** p Value < 0.05 significance ** p Value < 0.01 significance*

Table (4) showed that using opioids, inhalants, benzodiazepines, alcohol and cannabis predicted an increase of 2.8, 1.2, 0.8, 0.3 and 0.18 respectively in the score of number of perseverative responses. Using both alcohol + cannabis, opioids + cannabis and alcohol and inhalants predicted an increase of 1.4, 3.6 and 1.3 points respectively in the number of perseverative responses. Drugs of abuse explained 60.3% of the variance in the number of perseverative responses.

Table (4): Effect of different substances use on number of perseverative responses

	Unstandardized Coefficients		Standardized Coefficients	t	PValue
	B	Std. Error	Beta		
(Constant)	60.817	2.617		23.239	.000
Cannabis use disorder	-.181	.773	-.274	3.699	.722
Alcohol use disorder	-.354	.549	-.047	-.645	.521
Opioids use disorder	2.859	.623	.20	-.290	.002**
Benzodiazepines Use disorder	-.870	.698	-.091	-1.247	.216
Inhalants use disorder	-1.278	1.102	-.112	-1.159	.249
Alcohol + Cannabis	1.412	.861	.047	1.103	.042*
Opioid + Cannabis	3.611	1.071	.058	1.094	.034*
Alcohol + Inhalants	1.312	1.434	.091	1.061	.021*
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.800	.639	.603	2.934	

Table (5) showed a binary logistic analysis of demographics and TASI variables on the dependent variable (number of trials to first category). An increase of one degree in the severity peer social relationships predicted an increase of 0.87 points in the trials to first category that mean more deterioration of initial conceptualization. An increase of one degree in the severity of employment support predicted an increase of 0.75 points in the trials to first category that mean more deterioration of initial conceptualization. Demographics and TASI scores explained 50.1% of the variance in the trials to first category.

Table (5): Effect of demographics and TASI scores on number of trials to complete first category

Model		Unstandardized Coefficients		Standardized Coefficients	t	pValue
		B	Std. Error	Beta		
	(Constant)	28.372	2.467		11.502	.000
	Gender	-1.293	.827	-.090	-1.360	.158
	Residency	-.085	1.392	-.015	-.063	.952
	Hobbies	.124	.134	.083	.830	.423
	Education years	.152	.096	.131	1.578	.118
	Father Education	-.603	.163	-.478	-3.695	.000**
	Mother Education	.104	.124	.093	.840	.403
	Socio-Economic Scale	-.507	.294	-.156	-1.722	.089
	TASI-Chemical use	.447	.308	.124	1.451	.150
	TASI_School status	.251	.310	.065	.810	.420
	TASI_Employment support status	.755	.353	.168	2.138	.035*
	TASI_Family relation	.283	.252	.085	1.123	.265
	TASI_Peer social relationship	.870	.336	.195	2.588	.011*
	TASI_Legal status	.331	.188	.149	1.762	.082
	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	2	.742	.551	.501	2.568	

Table (6) showed a binary logistic analysis of demographics and TASI variables on the dependent variable (numbers of failure to maintain set). An increase of one degree in the severity of chemical use predicted an increase of 0.28 points in the failure to maintain set these mean that the more severe using the substances, the more deterioration of the executive function, specifically the ability to sustain attention. An increase of one degree in the severity of employment support predicted an increase of 0.15 points in the trials to first category. These mean that the more severe impairment of employment support, the more deterioration of the executive function, specifically the ability to sustain attention. An increase of one degree of SES predicted a decrease of 0.12 points in the failure to maintain set, which mean that socioeconomic status degree was protective against deterioration of executive function deterioration, specifically sustained attention. Demographics and TASI scores explained 34.6% of the variance in the failure to maintain set.

Table (6): Effect of demographics and TASI scores on number of failures to maintain set.

Model		Unstandardized Coefficients		Standardized Coefficients	t	p-Value
		B	Std. Error	Beta		
	(Constant)	.417	.675		.618	.538
	Gender	-1.496	.857	-.081	-1.560	.457
	Residency	-.067	1.491	-.026	-.163	.753
	Hobbies	.424	.234	.074	.731	.624
	Education years	-.008	.026	-.030	-.317	.752
	Father Education	.022	.045	.073	.496	.621
	Mother Education	-.091	.034	-.343	-2.694	.008**
	Socio-Economic Scale	-.120	.081	-.126	-.248	.005**
	TASI-Chemical use	.284	.084	.329	3.374	.001
	TASI_School status	-.121	.085	-.130	-1.426	.157
	TASI_Employment support status	.289	.097	.270	2.995	.004**
	TASI_Family relation	.024	.069	.030	.347	.729
	TASI_ Peer social relationship	.153	.092	.143	1.659	.101
	TASI_ Legal status	-.043	.051	-.081	-.837	.405
	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	2	.642	.412	.346	.703	

Table (7) showed a binary logistic analysis of demographics and TASI variables on the dependent variable (total number of errors). An increase of one degree in the severity of employment support predicted an increase of 5.1 points in the total number of errors. An increase of one degree in the severity of peer social relationships predicted an increase of 3.3 points in the total number of errors. Demographics and TASI scores explained 33.8% of the variance in the total number of errors.

Table (7): Effect of demographics and TASI scores on total number of errors

Model	Unstandardized Coefficients		Standardized Coefficients	t	pValue
	B	Std. Error	Beta		
(Constant)	40.544	11.665		3.476	.001
Gender	-1.163	.826	-.091	-1.358	.169
Residency	-.125	1.182	-.016	-.061	.963
Hobbies	.524	.234	.084	.835	.431
Education years	.389	.456	.082	.853	.396
Father Education	-.657	.771	-.127	-.851	.397
Mother Education	-1.062	.586	-.232	-1.811	.074
Socio-Economic Scale	-.414	1.392	-.031	-.297	.767
TASI-Chemical use	2.879	1.456	.194	1.977	.051
TASI_School status	-2.320	1.467	-.145	-1.581	.117
TASI_Employment support status	5.151	1.670	.280	3.085	.003**
TASI_Family relation	.948	1.191	.069	.796	.428
TASI_Peer social relationship	3.306	1.590	.180	2.079	.040*
TASI_Legal status	.043	.887	.005	.048	.962
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
2	.636	.405	.338	12.144	

Table (8) showed a binary logistic analysis of demographics and TASI variables on the dependent variable (number of perseverative errors). An increase of one degree in the severity of chemical use predicted an increase of 1.6 points in the number of perseverative errors. These mean that the severity of substance use affected the executive function, specifically the degree of impairment of cognitive flexibility. An increase of one degree of SES predicted a decrease of 0.18 points in the number of perseverative errors. These mean that socioeconomic status had a protective effect on executive functions specifically cognitive flexibility. Demographics and TASI scores explained 33.6% of the variance in the number of perseverative errors.

Table (8): Effect of demographics and TASI scores on number of perseverative errors

Model	Unstandardized Coefficients		Standardized Coefficients	t	pValue
	B	Std. Error	Beta		
(Constant)	20.048	6.477		3.095	.003
Gender	-1.168	.916	-.028	-.527	.008**
Residency	-2.128	.623	-.146	2.698	.01**
Hobbies	1.906	.718	.124	-2.349	.012*
Education years	.228	.253	.084	.900	.371
Father Education	-.303	.428	-.103	-.707	.481
Mother Education	-.731	.325	-.282	-2.247	.027*
Socio-Economic Scale	-.182	.773	-.111	-.106	.016*
TASI-Chemical use	1.671	.809	.198	2.066	.042*
TASI_School status	-1.428	.815	-.158	-1.753	.083*
TASI_Employment support status	2.819	.927	.270	3.041	.003**
TASI_Family relation	.764	.661	.098	1.155	.251
TASI_Peer social relationship	2.101	.883	.202	2.380	.019*
TASI_Legal status	-.029	.493	-.006	-.060	.953
R	R Square	Adjusted R Square	Std. Error of the Estimate	R	
.656	.430	.366	6.743	.656	

Table (9) showed a binary logistic analysis of demographics and TASI variables on the dependent variable (number of perseverative response). An increase of one degree in the severity of chemical use predicted an increase of 1.8 points in the number of perseverative responses. These mean that the severity of substance use affected the executive function, specifically the degree of impairment of cognitive flexibility. An increase of one degree of SES predicted a decrease of 0.43 points in the number of perseverative responses. These findings indicated that socioeconomic status protected executive function, specifically cognitive flexibility. Demographics and TASI explained 44.5% of the variance in the number of perseverative responses.

Table (9): Effect of demographics and TASI scores on number of perseverative responses

Model		Unstandardized Coefficients		Standardized Coefficients	t	pValue
		B	Std. Error	Beta		
	(Constant)	33.835	3.304		10.240	.000
	Gender	-2.093	.927	-.081	-1.160	.147
	Residency	-.089	1.092	-.019	-.051	.841
	Hobbies	.129	.039	.081	.831	.321
	Education years	.069	.129	.046	.532	.596
	Father Education	-.503	.219	-.311	-2.304	.024*
	Mother Education	.207	.166	.145	1.245	.216
	Socio-Economic Scale	-.436	.394	-.105	-1.106	.042*
	TASI-Chemical use	1.819	.413	.393	4.409	.000**
	TASI_School status	.432	.416	.087	1.039	.301
	TASI_Employment support status	1.156	.473	.201	2.444	.016*
	TASI_Family relation	.253	.337	.059	.750	.455
	TASI_Peer social relationship	1.053	.450	.184	2.337	.022*
	TASI_Legal status	.110	.251	.039	.439	.662
	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	2	.714	.510	.455	3.440	

Table (10) showed a binary logistic analysis of demographics and TASI variables on the dependent variable (number of non-perseverative errors). An increase of one degree in the severity of employment support predicted an increase of 2.3 points in the number of non-perseverative errors. These mean that employment affected executive function specifically problem-solving abilities. Demographics and TASI scores explained 22.7% of the variance in the number of non-perseverative errors.

Table (10): Effect of demographics and TASI scores on number of non-perseverative errors

Model		Unstandardized Coefficients		Standardized Coefficients	t	pValue
		B	Std. Error	Beta		
2	(Constant)	20.496	6.089		3.366	.001
	Gender	-2.184	.827	-.073	-1.150	.268
	Residency	-.235	1.392	-.065	-.072	.772
	Hobbies	.421	.134	.076	.630	.653
	Education years	.161	.238	.070	.677	.500
	Father Education	-.354	.403	-.141	-.878	.382
	Mother Education	-.330	.306	-.150	-1.080	.283
	Socio-Economic Scale	-.332	.726	-.051	-.457	.649
	TASI-Chemical use	1.208	.760	.169	1.590	.115
	TASI_School status	-.892	.766	-.116	-1.165	.247
	TASI_Employment support status	2.332	.871	.262	2.676	.009**
	TASI_Family relation	.184	.621	.028	.296	.768
	TASI_Peer social relationship	1.205	.830	.136	1.452	.150
	TASI_Legal status	.072	.463	.016	.155	.877
	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
	2	.552	.305	.227	6.339	

DISCUSSION

The study was conducted in 2021 at the Faculty of Medicine, Suez Canal University Hospital and the Psychiatry Hospitals Clinics of the Suez Canal Regional Area to examine the impact of substance use on executive function in adolescents who were not developmentally or psychologically impaired and who were primarily from the same cultural background. 140 patients were studied where they were divided into two groups of 100 cases and 40 controls, and were submitted to clinical assessment, toxicological test, semi-structured interview (mini-kid), Adolescent Addiction Severity Index scale, WCST, and social classification scale.

We studied the sample from multiple perspectives including socioeconomic factors, correlation and comparison between the cases group and control group, followed by regression analysis between all the mentioned factors in a multi modal example of the used scales, which differentiated our net result.

Parent's education affected all executive functions domains significantly of the studied group in a protective way and this is going along side with **Ardila *et al*.** [12] in Mexico, Colombia and Vietnam. Although **Fatima *et al*.** [13] in a similar study done in Pakistan specified that parents' education has mainly a protective effect against problem solving deterioration of their adolescent with substance use disorder executive functions.

The socioeconomic state of the family significantly affected executive function of their adolescents in all executive functions' domains in parallel way, the higher socioeconomic state the more preserved executive functions and this is going along side with **Maddahian** [14] and **Elliott** [15] in San Francisco and Pennsylvania respectively. Also, with the study done in turkey by **Tulin,** [16] and the study done by **Hook *et al*.** [17] in Pennsylvania. In contrast, in a study conducted by **Sarsour *et al.*** [18] in California and **Deer *et al*.** [19] in United Kingdom, they discovered that the low socioeconomic state affected all executive functions domain specially the cognitive flexibility.

It was against the study done by **Rafiee *et al*.** [20] in Tehran, who claimed that substance use by adolescents who grew up in an urban area, have poor executive functions due to chronic exposure to environmental pollutions. This might suggest that this finding is valid in developing countries. The study done in Canada by **Diamond** [21] found that the content of School curriculum, which contain social and physical activities affect executive functions significantly. And this may be due to multiple mechanisms i.e. socially or educationally.

As regards our results on the severity of substance use effect on executive function matching the majority of the studies done to test this factor like in Brazil by **Formiga *et al*.** [22], going side by side and came out by the same result of global deterioration of executive function regarding the long duration and heavy use.

After performing a correlation matrix, we used a regression analysis to explore any predictive values of the study variables on the scores of the WCST, while attempting to adjust for the confounding factors. We could define two main significant models: a) specific substances b) demographics and TASI.

We used regression analysis to confirm the relation between type of drugs and the different domains of the executive functions. We found that cannabis, inhalants, alcohol, opioids and benzodiazepine use predicted a decrease of 1.9, 1.7, 0.9, 0.4 and 0.15 respectively of the score of the number of categories completed, and this is going along side with a study done by **Bondallaz *et al*.** [23]. Cannabis, inhalants, opioids, benzodiazepine and alcohol use predicted an increase of 2.6, 2.1, 0.7, 0.49 and 0.42 respectively of the score of the number of trials to first category. And this is going along side with the studies done in India by **Rathee *et al*.** [24] and in Brazil by **Formiga *et al*.** [22]. Inhalants and cannabis predicted an increase of 0.3 and 0.2 respectively in the score of the number of failures to maintain set. And this is going along side with the study done in Mexico by **Alonso-Matías *et al*.** [25].

We found in regression analysis that poly-substance use is more harmful to most of the executive function domain than mono-substance uses by approximately 1.5 ± 0.5 respectively on non-perseverative errors, number of categories completed, trials to first category, failure to maintain set, and perseverative response. And this is going along side with the study done in United States by **Bourgault *et al*.** [26].

The socioeconomic status regressive analysis found that socioeconomic status had a protective effect on the number of perseverative reactions, perseverative error and failure to maintain set, as one degree increase on the level of socioeconomic status decreased the number of those domains by 0.43, 0.18, 0.12 respectively and these findings are very similar to the study done in nearby culture countries, Brazil by **Galvão *et al*.** [27].

CONCLUSION

In conclusion, smoking, cannabis and alcohol, are the most widely used substances by adolescents. Multiple executive function domain affection and poly-substances are the common role not the reverse in adolescents.

DECLARATIONS

- **Consent for publication:** I attest that all authors agreed to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
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