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Substance use disorder, is it related to type 2 diabetes? An analytical cross-sectional study, among patients admitted to MOH addiction hospital in Jeddah, Saudi Arabia 2021

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ABSTRACT

Background: The association between substances use disorder and type 2 diabetes mellitus, is an under-studied topic. Since type 2 diabetes is a major health issue, it requires a comprehensive knowledge of all aspects regarding its etiology and risk factors. *Objective:* To understand the association between different substance abuse and type 2 diabetes among patients admitted to the Ministry of Health (MOH) addiction hospital in Jeddah, Saudi Arabia. *Methods:* This is an analytical cross-sectional study. Data were retrieved from the patient's records over the year of 2021. Random sampling was applied to include the patients. The data collection sheet was created by the researcher. Data analysis was done using the statistical package for the social sciences (SPSS, version 27.0). *Results:* A total of (322) patients were included in the analysis. Amphetamines were the most common used substance 55.3%, followed by Cannabis 53.1%. Of the total, 8.4% had diabetes. Two thirds (66.7%) were taking medications, and only three cases (1.1%) had controlled blood glucose levels. Among those whom diabetes was not controlled, the HbA1c mean was 9.9%±1.6. Regarding other comorbidities, 11.1% had psychiatric illnesses, 2.5% had hepatitis C virus and 1.2% had HIV. Longer durations of abuse and Cannabis use were significantly associated with diabetes (P-value=0.02, P-value<0.001), respectively. *Conclusion:* The prevalence of diabetes among substance use patients was (8.4%), and the majority of which had uncontrolled blood glucose levels. While most substances were not associated with diabetes, cannabis showed a significant association in our sample.

Keywords: Alcohol, Amphetamines, Cannabis, Diabetes, Substance abuse

1. INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a well-known global health issue that has been widely increasing throughout the years. With the increase in

urbanization, the prevalence of T2DM is expected to continue to rise (Khan et al., 2020). It was estimated that substance use affects 16 million individuals globally, in which they are affected by opioid use disorder (Azadfard et al., 2022). The health, quality of life, economic burden, and all devastating consequences of T2DM, require a comprehensive coverage and clear knowledge of all aspects of diabetes' etiologies and risk factors. The study of this relation could be an eye opener for future prediction and prevention. The prevalence of substance use disorder (SUD) was estimated to be 4.2% among patients diagnosed with type 2 diabetes mellitus (T2DM), which is higher when compared to the general population (2.1%) (Wu et al., 2015). A higher prevalence was reported in data obtained from the electronic health records (EHRs) from the Duke uuniversity health system, used to identify high-risk diabetic patients, estimated the prevalence of SUD among diabetic patients to be as high as 50% (Wu et al., 2018). It is known both by common sense and scientifically from studies, that regular illicit drug users with diabetes, often have poor diabetic control and more frequent diabetes related complications and hospital admissions (Clark et al., 2009; Leung et al., 2011).

Mainly, more hospital admissions are due to diabetic ketoacidosis (DKA) and hyperglycemic attacks. Furthermore, higher mortality rates have been observed in diabetic drug user's compare to non-drug users (Saunders et al., 2004). A retrospective study also suggested that cocaine use is likely to be associated with recurrent DKA in diabetic patients (Nyenwe et al., 2007). Going through the literature, this can be explained in many ways. There is a logical relation of being a drug addict with self-negligence and poor self-care, which leads to noncompliance to medications, follow up appointments and screening visits. This behavior eventually leads to critical complications and more hospital admissions (Ghitza et al., 2013; Williams et al., 2012). In context with the rational consecutive relation, some literature suggests an etiological and biological association. An indirect hormonal effect were reported in a study, which showed that opiates and cocaine changes the gonadal and adrenal functions, leading to hormonal changes that alter the body's composition, leading to increased fat mass, which is strongly related to insulin resistance (Bhasin, 2003). Also some substances increase the release of catecholamines and cortisol, and these hormones are known to cause elevation in blood sugar and inhibition of insulin secretion (Sheldon & Quin, 2005).

Amphetamines likewise join the characteristic of increasing the release of catecholamines (Ng et al., 2004). Moreover, an etiological relation between heroin and T2DM was suggested, in a study of heroin-dependent subjects, in which they had higher fasting insulin, whilst the plasma insulin response (first phase\acute insulin response) to intravenous glucose administration was significantly lower compared to non-users. In addition, a lower glucose utilization rates were noted. All those findings resemble similar ranges found in an insulin resistant diabetic patient. Those findings support the fact that narcotics impair insulin secretion (de Vries et al., 2020). Thus, in many aspects, the chronic use of narcotics places the person in a state similar to an insulin-dependent-diabetes, hypothesizing the possibility of a causal relation. Supporting the latter theory, a study concerned with the onset of T2DM, showed that diabetic patients who used alcohol, illicit drugs, or combined substances reported an earlier onset of T2DM, and suggested to include SUD screening as a possible risk factor for T2DM (Johnson et al., 2000).

We noticed that SUD in patients with T2DM is an understudied matter. As abstinence from substance use better diabetic control, consequences and lower mortality rates (Walter et al., 2017). As the globalism of diabetes is on the rise, diabetes in Saudi Arabia is rising as well. As it's considered globally as one of the top ten countries and the third among middle eastern and North Africa countries (El-Kebbi, 2021). Drug addiction in Saudi Arabia is strictly prohibited legally and religiously, and there is a social stigma of being a drug addict, which may raise the concern that the numbers are underreported and not representative. In this study, our objective was to investigate the relationship between substance abuse and type 2 diabetes among patients admitted to the Ministry of Health (MOH) addiction hospital in Jeddah, 2021.

2. METHODOLOGY

Study design

This is a center-based analytical cross-sectional study that was conducted among patients being treated for substance abuse in Jeddah, Saudi Arabia. It was conducted from 1st November 2021 to 30th May 2022.

Study area

This study was conducted in Jeddah city, Saudi Arabia. In Jeddah, Eradah complex for mental health is the only MOH hospital available, with a bed capacity of 245, and a comprehensive management of all patients suffering from addiction of all kinds of substances.

Study population

The study population comprised of addiction patients admitted to ministry of health (MOH) addiction hospital in Jeddah city, throughout the whole year of 2021. All patients with history of admission to MOH addiction hospital in Jeddah city, during 2021 were included in the study. Patients with type 1 diabetes mellitus were excluded from the study.

Sample size

The sample size was calculated using a web-based calculator (Roasoft), with a confidence interval of 95% and a marginal error of 5%. We applied the total number of patients admitted to a facility for Mental Health "Eradah Complex" in the year 2021 in Jeddah (1747) as the population size, using a response distribution of 50%. The calculated sample size was (316).

Sampling technique

The full list of all patients, who were admitted through the year 2021, was obtained from hospital administration. Thereafter, we used a random sampling for all the patients, using random number generator website (http://www.random.org), the minimum and the maximum numbers in the list were entered, and the generated numbers were considered for data collection.

Data collection tool

Data were collected using a form created by the researcher. The tool obtained data about patient's medical numbers (MRN), sociodemographic data (Age, gender, nationality, educational level, economic status, height, weight, occupation, and marital status), the abused substance (Amphetamines, Cocaine, Heroin, other opioids, Cannabis, Alcohol, Khat, and other substances), the duration of substance use, smoking status, medical history, and type 2 diabetes status as a binary outcome variable (yes or no).

Data collection technique

Data were collected on a weekly-basis every Thursday for two consecutive months by the primary investigator. A dedicated computer in the library of Eradah medical complex was used for the extraction of data. The variables of interest were retrieved from hospital computers or paper files as applicable, using the created form for data collection. A patient was considered diabetic based on the following diagnostic criteria from the 2022 American Diabetes Association (ADA) guide: a fasting plasma glucose (FPG)≥7.0 mmol/L, or 2-hoursplasma glucose ≥11.1 mmol/L during oral glucose tolerance test (OGTT), or HBA1C of ≥ 6.5%, or a random plasma glucose (RPG) ≥ 11.1 mmol/L plus the presence of signs and symptoms of type 2 diabetes, or symptoms of hyperosmolar hyperglycemic state (HHS) or Diabetic ketoacidosis (DKA) (American Diabetes Association, 2022).

Statistical analysis

A computer program was used for the statistical analysis, the statistical package for the social sciences SPSS Statistics for Mac, version 27.0 (SPSS Inc., Chicago, Ill., USA). Continuous variables were summarized using means and standard deviations (SD) after applying the Shapiro-Wilk to confirm the normal distribution. Categorical variables were presented using proportions and contingency tables. As the number of diabetic cases was low, the data failed to fulfil the sample size assumption of Chi-square test of 20% cell count less than five. Instead, Fisher exact test was used to test the significant associations between the categorical variables. For continuous independent variables, binary logistic regression was used to test for the significance with the presence of T2DM. P-values<0.05 were considered significant.

Ethical consideration

An ethical approval was obtained from the institutional review board (IRB) of the Saudi Ministry of Health (Ethical approval code: A0157). After obtaining the ethical approval, permission from the hospital administration for data access was obtained as well. The data were collected by the primary investigator and kept in the personal computer to maintain confidentiality of the data. At the analysis stage, the MRN were replaced by codes and data were handled anonymously. Furthermore, the collected data were used for research purposes only.

3. RESULTS

The total analyzed number of patients was (322). The mean age was 35±8.1 with male gender representing the majority of the sample (91.9%). The entire collected samples were from patients being treated for substance abuse. Body mass index (BMI) was also calculated based on the documented anthropometric measures of the patients; the mean for BMI was 25.2±5.3. Mostly the patients

had normal BMI 41%, overweight 29.5%, obese 12.7%, and only 5.9% were underweight. The sociodemographic characteristics of the patients including gender, nationality, marital status, education, occupation and economical status are shown in (Table 1).

Table 1 The sociodemographic characteristics of the patients

		N (%)
Gender	Male	296 (91.9%)
	Female	26 (8.1%)
Nationality	Saudi	311 (96.6%)
	Non-Saudi	11 (3.4%)
Marital status	Married	94 (29.2%)
	Unmarried	146 (45.3%)
	Divorced	82 (25.5%)
Educational level	Less than primary school	2 (0.6%)
	Primary school	30 (9.3%)
	Middle school	40 (12.4%)
	High school	159 (49.4%)
	Diploma	29 (9%)
	Bachelor	60 (18.6%)
	Master	2 (0.6%)
Occupation	Student	8 (2.5%)
	Soldier	29 (9%)
	Teacher	10 (3.1%)
	Office worker	49 (15.2%)
	Retired	26 (8.1%)
	Other	34 (10.6%)
	Unemployed	166 (51.6%)
Monthly income	100 to < 3000 SAR	163 (50.6%)
	3000 to < 6000 SAR	130 (40.4%)
	6000 to 11000 SAR	20 (6.2%)
	Above 11,000 SAR	9 (2.8%)

The diabetic patients were 27 (8.4%) of the total sample. Of the diabetic patients, two thirds (66.7%) were taking medications, and only three cases (1.1%) were controlled. Among those whom DM was not controlled, the HbA1c mean was 9.9%±1.6. Upon investigating other comorbidities, 11.1% had psychiatric illnesses, 2.5% had hepatitis C virus and 1.2% had HIV. The details about diabetes and other related medical history are shown in (Table 2). Regarding the substances used among the patients, Amphetamines were the most common used substance 55.3%, followed by Cannabis 53.1%. The mean duration of abuse was 11.9±8 years. The proportions of substances use are demonstrated in (Figure 1).

Table 2 Medical history of the patients

		N (%)
Diabetes mellitus	Yes	27 (8.4%)
	No	295 (91.6%)
Pre diabetic	Yes	7 (2.2%)
	No	315 (97.8%)
Medication	Insulin	6 (23.1%)
	Oral hypoglycemic agents	12 (46.2%)
	None	8 (30.8%)
Control of diabetes	Yes	3 (13%)
	No	20 (87%)
Other diseases	None	226 (70.2%)

Hypertension	14 (4.3%)
Schizophrenia	12 (3.7%)
Depression	12 (3.7%)
Hepatitis C	8 (2.5%)
HIV	4 (1.2%)
Bipolar	8 (2.5%)
Other psychiatric	4 (1.2%)
Other	34 (10.6%)

Different types of substances and duration of abuse were tested for significance. Longer durations of abuse were significantly associated with DM (B=0.055, P-value=0.02). It was also shown that Cannabis was significantly associated with DM (P-value<0.001). The cross-tabulation of substances with DM is shown in (Table 3). 2.2% of the total sample was prediabetics with no significant association with any substance.

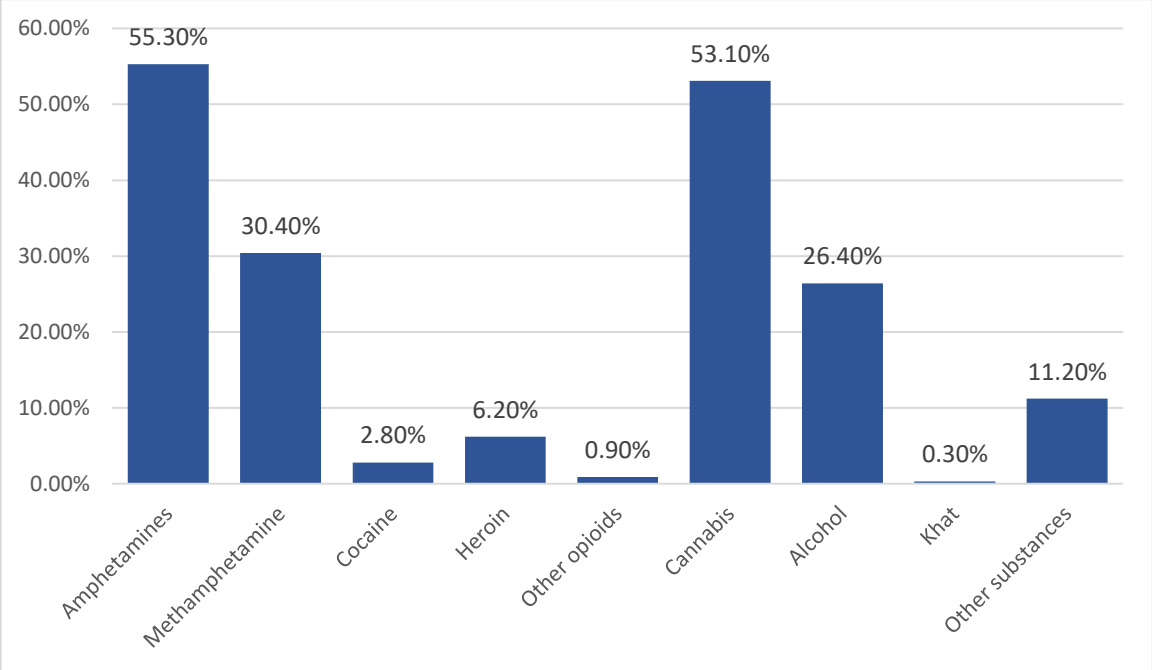

Figure 1 Types of substances used among the patients

Table 3 The association between types of substances and diabetes mellitus

		DM		P-value
		Yes (%)	No (%)	
Amphetamines	Yes	17 (9.6%)	161 (90.4%)	0.427
	No	10 (6.9%)	134 (93.1%)	
Methamphetamine	Yes	7 (7.1%)	91 (92.9%)	0.668
	No	20 (8.9%)	204 (91.1%)	
Cocaine	Yes	1 (11.1%)	8 (88.9%)	0.550
	No	26 (8.3%)	287 (91.7%)	
Heroin	Yes	3 (15%)	17 (85%)	0.229
	No	24 (7.9%)	278 (92.1%)	
Other opioids	Yes	0 (0%)	3 (100%)	1.000
	No	27 (8.5%)	292 (91.5%)	
Cannabis	Yes	5 (2.9%)	166 (97.1%)	<0.001
	No	22 (14.6%)	129 (85.4%)	
Alcohol	Yes	6 (7.1%)	79 (92.9%)	0.820

	No	21 (8.9%)	216 (91.1%)	
Khat	Yes	0 (0%)	1 (100%)	1.000
	No	27 (8.4%)	294 (91.6%)	
Other substances	Yes	0 (0%)	36 (100%)	0.056
	No	27 (9.4%)	259 (90.6%)	

4. DISCUSSION

To our knowledge, this research is the first to determine the association between substance use and type 2 diabetes in Saudi Arabia. Our findings showed that (8.4%) of substance abuse patients were diabetic and mostly were not controlled with a mean of HbA1C (9.9). A possible explanation is the lack of motivation to improve health, unhealthy lifestyle and incompliance to the treatment, especially among patients with drug use disorders. For those patients, more assessments are required to detect the possible reasons for the low compliance to treatment. Moreover, structured education and counseling can show great benefits to enable patients for more self-management behaviors and skills. It is worth mentioning that patients with diabetes and substance use disorders are more susceptible to diabetes-related complications which can be associated with higher healthcare costs (Leung et al., 2015; Wu et al., 2018). Moreover, it is well-known that drug abuse deteriorates metabolic control and is associated with high risk of chronic complications and acute metabolic decompensation (Karam et al., 2004).

Findings from the analyses showed a significant association between diabetes and the use of Cannabis. Potential explanations include the appetite-stimulating effect of cannabis use which leads to the tendency to consume more carbohydrates (Okafor et al., 2020). It is worth mentioning that evidence showed that although cannabis use has an appetite-stimulating effect which results high calorie consumption, it was not associated with increased BMI (Okafor et al., 2020). Another possible explanation is the suppressive effects of cannabis which leads to a sedentary lifestyle, especially among heavy users. In contrast, a previous cross-sectional study showed no significant association between cannabis use and diabetes (Danielsson et al., 2016).

The authors reported that Cannabis users were more susceptible to morbid behaviors including heavy alcohol consumption and reduced physical activity (Danielsson et al., 2016). Another cohort study showed a significant association between Cannabis and pre-diabetic status (Bancks et al., 2015). This association was significant among those who have consumed cannabis more than 100 times, while the association with pre-diabetes came after adjusting for demographic characteristics, tobacco smoking, alcohol consumption, and dietary patterns (Bancks et al., 2015). In contrast, an inverse association between cannabis and diabetes was suggested by another study (Alshaarawy & Anthony, 2015). However, the authors concluded that this protective association can be spurious, and more definitive studies are needed to determine the real association between diabetes and substance use (Alshaarawy & Anthony, 2015). This controversy can be explained by the under-reporting of diabetes by drug users, particularly in self-reporting studies. Also, the dose and duration of cannabis use may differ between the studies. In another study, while not significant, it was suggested that increased frequency of cannabis use reduces the risk of diabetes (Okafor et al., 2020).

In our study, however, a longer duration of substance use showed a significant association with diabetes. Although our findings showed insignificant association between alcohol use and diabetes, other studies showed controversial findings. A recent systematic review showed that alcohol consumption decreases blood glucose and causes ethanol-induced hypoglycemia. In the same study, it was suggested that hypoglycemia was due to low adherence to insulin doses and high consumption of carbohydrates rather than ethanol-induced hypoglycemia (Tetzschner et al., 2018). The provided findings in this study add to the literature and provide important information regarding substance use and diabetes nationally. Indeed, the restriction of studies regarding substance use due to ethical and practical concerns globally leads to the scarcity of similar studies, which is considered strength of this study. Another strength point of this study is the method of data collection from patients' records rather than self-reported questionnaires, which allowed the elimination information bias.

The limitations of this study related to the nature of the cross-sectional design which precludes the casual association. Also, cross-sectional studies are not designed to support temporal inferences. Since this study includes data from the patients' registries, it is difficult to determine whether our findings suggest a direct physiological effect of substance use or due to associated behaviors, incompliance with treatment, or diagnostic misclassification. In addition, since our data was gathered from a single geographical area, this can limit the generalizability of the results.

5. CONCLUSION

In conclusion, the association between substance use and diabetes remains controversial. Our study showed that the prevalence of diabetes among substance use patients was (8.4%), and the majority of which had uncontrolled blood glucose levels. While most

substances were not associated with diabetes, Cannabis showed a significant association with diabetes in our sample. Also, a significant association was found between the duration of substance use and diabetes. Our findings provide important information and add to the literature. Conducting further studies regarding substance use and diabetes is recommended to determine the causality and temporality. In addition, national studies are recommended to determine the national prevalence and provide more generalizable data. Moreover, secondary prevention by screening and early detection of diabetes among substance use patients is recommended to prevent diabetes-related complications. Due to the lack of compliance among diabetic drug users, focused behavioral management in addition to individualized counseling and education are recommended to reduce the risks of complications.

Authors' contributions

Hana J. Gadah designed the study's conceptual framework and wrote the research proposal also did data collection and analysis, wrote the manuscript draft.

Hani A. Alghamdi contributed to designing the study's conceptual framework and supervised the research conduction.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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