Original Article

An Assessment of Falsely Convicted Type 1 Diabetics in Jamaica by Using the Breathalyzer Test

Endocrinology Section

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ABSTRACT

Objective: The close similarity between the symptoms of alcohol intoxication and low blood glucose levels makes it difficult for breathalyzers to make the distinction between a diabetic and an individual who is driving under the influence (DUI) of alcohol or driving while intoxicated (DWI). In Jamaica, it is illegal if a person's blood alcohol concentration (BAC) is ≥ 35 microgram per 100 milliliter of breath on the breathalyzer and the intoxilyzer devices. The aim of the present study was to examine the extent to which the breathalyzer test provided false blood alcohol measurements in persons with type 1 diabetes mellitus.

Design: The purposive and snowball sampling methods were used to collect information from motorists who were accused and charged by the police for DUI/DWI. Data was collected during the period from 2007-2009, from respondents at the St. Andrew Traffic Court, at their work stations and other convenient locations. The data were stored and analyzed by using SPSS version 17.0.

Results: Of the 53 respondents, 73.6% were of type 1 diabetes mellitus status and 53.8% were those who were suspected by the police to be DUI/DWI and hence, the breathalyzer test resulted in 42.9% of the respondents showing a reading of ≥ 35 microgram per 100 millilitre of breath. The findings showed a correlation (β = 0.75) between the respondents with type 1 diabetes mellitus and wobbly (41.7%) and faintish/dizzy (20.8%) equilibrium when examined by the police. There was a high association between the diabetics who were unlikely to consume alcohol and those who were unlikely to be DUI/DWI (C = 0.725, P < 0.01, β= 0.01). The respondents of type 2 diabetes were 14 (26.4%), of which 8 failed the breathalyzer examination and were subjected to a blood test.

Conclusions: Motorists with type 1 diabetes mellitus, who were subjected to a breathalyzer examination, were charged and they faced the court for being accused of DUI/DWI. The ignorance of the police officers and the respondents on this matter can result in similar repeated cases of this nature.

Key Words: Diabetes mellitus, Alcohol, Driving, Breathalyzer

INTRODUCTION

Diabetes mellitus comprises a group of complex metabolic disorders in which elevated blood glucose levels can result in serious medical complications. Type 1 diabetes arises from the lack of insulin which is caused by the auto-immune destruction of the insulin producing βcells in the pancreatic islets of Langerhans and requires lifelong insulin therapy. Insufficient insulin may result in hyperglycaemia and ketosis may develop [1]. In acute diabetic ketoacidosis (DKA), there is increased lipolysis in the adipose tissue and increased ketogenic flux in the liver, resulting in a rise in the circulating ketone bodies, namely acetoacetate (AcAc), beta-hydroxybutyrate (BHB) and acetone. In DKA, the ketone body ratio (BHB: AcAc) rises from normal (1:1) to as high as 10:1.

Acetone is formed by the decarboxylation of acetoacetate and it contains two methyl groups that absorb infrared radiation in the 3.4 micron region of the spectrum. It is considered as a normal constituent of the breath of healthy persons [2], albeit in a very low concentration. In type 1 diabetics, the concentration of the breath acetone is highest in the morning [3]. The acetone concentration in the breath ranges from a relatively high 0.5 ppmv for healthy individuals to hundreds of ppmv for critically ill, ketoacidotic diabetics [4]. The National Highway Traffic Safety Administration (NHTSA) in the USA has found that dieters and diabetics may have acetone levels which are hundreds and even thousand of times higher than those in others [5]. Acetone is one of the many substances that can be falsely identified and measured as ethanol by some breathalyzer machines. The first generation of infrared breath-alcohol analyzers uses a single wavelength infrared filter (3.4 μm) and therefore is not able to distinguish ethanol from acetone in a person's breath.[6] Elevated concentrations of acetone in blood and breath can occur during fasting, due to the consumption of low carbohydrate diets or in poorly treated diabetes mellitus [6]. This study examined the extent to which the breathalyzer tests provided false blood alcohol measurements in individuals with type 1 diabetes mellitus.

MATERIALS AND METHODOLOGY

Data collection procedure: This study utilized both quantitative and qualitative approaches. The former represented field work by using an interview schedule, while the latter pertained to secondary data from the desk research of legislation and the work of other scholars. The field work engaged a sample size of 53 diabetics from whom the information was collected - via face-to-face and telephone interviews. This was done by using a 26-item interview schedule. In addition, an elite interview was conducted with law enforcement officers at the senior levels. Practical demonstrations on the use of the breathalyzer and the intoxilyzer were done. The methods of sampling in this study were the purposive and the snowball types. In the method of purposive sampling, the researchers selected a sample based on their experience or knowledge of the group which was to be sampled [7] and this was used to collect information from motorists who were accused and charged by the police for DUI/DWI. Snowball sampling

is a non-probability sampling technique, whereby the researcher collects data on a few members of the target population, who may be difficult to locate. These individuals may be asked to recommend other individuals to provide information, based on similar cases as theirs [8]. Face-to-face interviews were conducted under the purposive method, while telephonic conversations was deemed to be more suitable (by the respondents) for the latter. At the start of the interview, the respondents were told about the nature of the study, its scope for the policy-legislative improvement and the sensitization of the law enforcement officers, and the level of confidentiality that would be exercised.

The data was collected during the period from 2007-2009, from respondents at the St. Andrew Traffic Court, individual's work stations and other locations, as well as via the telephone. Although the face-to-face interviews were concentrated in the parishes of Kingston and St. Andrew, some of the respondents were from other parishes in Jamaica. The respondents who were charged by the police while driving in the corporate area, were expected to be present before a resident magistrate in the parish where their cases resided.

Instrument design: The 26-item interview schedule reflected 3 overarching considerations, namely: demographic characteristics (gender, age, occupation); medical/health status (type of diabetes, equilibrium condition when stopped by the police, the period of time for meal consumption prior to a breathalyzer test); and socio-legal status (alcohol consumption, breathalyzer result, verdict in terms of being charged and court's decision). The close-ended instrument was intended to assess the diabetic and alcohol status of the respondents; the knowledge of the law enforcement officers regarding the similarity of the acetone in the breath of a diabetic versus an alcohol-ingested individual; and how such a matter was treated under the law.

Protocol on the breathalyzer test and on the arresting of individuals: A driver is usually asked to comply with a breathalyzer test if the police suspects him/her to be driving under the influence/driving while intoxicated (DUI/DWI), or if there is a motor vehicle accident. Apart from a breathalyzer test, the suspect is subjected to a sobriety test (that is walking in a straight line); asked to speak to detect slurred speech and the suspect's eyes are looked closely at to see whether they are glossy. If these are evident, then the police would declare that such an individual is in no condition to drive.

Where the motorist's blood alcohol concentration (BAC) is ≥ 35 microgram per 100 milliliter of breath on the breathalyzer device, the motorist is thereafter taken to the station to do an intoxilyzer, which produces a receipt of the reading. The motorist's information that is captured on this receipt are name, date and place of birth, current address, driver's license number, date of issue for driver's license, the registration number of the motor vehicle, the place of the intoxilyzer screening, the date of screening, the time of screening, the reason for the screen/test (suspicion or accident), the name of the officer, the officer's number, the name of the operator (analyst) of the intoxilyzer, the registration number of the analyst, and the confirmation of correct information.

Copies of the receipt which are produced by the intoxilyzer, are provided to the investigating officer and the motorist, and they are also placed on the motorist's file and taken to court. Where the motorist is placed under arrest, he/she becomes liable to face the court, thus resulting in a US$110.00 fine or 6 months in prison. In addition, the individual's driver's license would be suspended for one year.

Only special police who are referred to as analysts, are allowed to conduct the BAC-related tests, as they are gazetted, specially trained to use the devices, promulgated and approved by the Minister of National Security. There are 20 breathalyzer centres throughout the parishes of Jamaica. When a suspect failed to comply with the police in adhering to a breathalyzer test, or to give sufficient breath that was required for a proper reading by the device, then such an individual was subject to be charged. If the suspect was unable to give a breathalyzer test for the reason of medical or other conditions, then such an individual would be allowed the option of a blood test. When the individual was taken from an accident scene to the hospital and became admitted, such a person could refuse both the breathalyzer and the blood tests while in hospital. Such a person would not be charged. If the individual agreed, the blood would be usually drawn and tested by medical personnel. Where a blood test was done, the suspect would be given a sample of the said blood, so that he/she could take it to another laboratory if he/she so wished, for the reason of transparency. Section 34D (1, 2, 3) of the Jamaican legislation made provision for this. The said legislation states specifically that "any person is required to provide a specimen of blood - such a specimen shall be taken only with the consent of that person; at a hospital and by a medical practitioner or a qualified laboratory technician" [9].

Statistical analysis and technique: The primary data were stored and analyzed by using SPSS version 17.0. Frequencies were used to determine the number and percentage responses to the variables which were involved. Cross tabulations were also used to determine the relationships between the respective variables. The data analysis also included a wide range of correlation coefficients such as Chi square, contingency coefficients and Cramer's V.

RESULTS

A majority of the respondents (73.6%) of this study were of the diabetes mellitus type 1 status as compared to the type 2 diabetes mellitus (26.4%). The respondents were mainly males (77.4%) as compared to the females (22.6%); who were within the age range of 20-39 (37.8%), 40-59 (37.8%) and ≥ 60 (24.6%) years old; and were professionals (52.8%), business operators (20.8%) and trade personnel (26.4%) [Table/Fig-1].

Socio-demographic variables	Number	Percent
Gender of respondents		
Male	41	77.4
Female	12	22.6
Age range		
20-39	20	37.8
40-59	20	37.8
60 and over	13	24.6
Occupation		
Professional	28	52.8
Business	11	20.8
Trade	14	26.4
Diabetic status of respondents		
Type 1	39	73.6
Type 2	14	26.4
Uncertain	8	15

[Table/Fig-1]: Demographic characteristics and medical status

[Table/Fig-2] intimates, that of the type I diabetics (73.6%), a majority (41.7%) showed wobbly disposition during the sobriety tests which were carried out by the police, who pulled them over (while driving) for the reason of being DUI/DWI suspects or just for regular security checks. The findings of this study also showed a correlation (χ^2 = 0.75) between the respondents' unstable equilibrium and the period between their last meal, prior to the breathalyzer test. A majority of the respondents (50%) claimed to have been feeling hungry, having not consumed a meal many hours prior to the test. This was followed by those who ate ≤ 1 hour prior (20.8%), 2-4 hours prior (20.8%) and ≥ 5 hours prior (8.3%) to the test.

None of the respondents were cognizant that persons with diabetes mellitus (especially type 1) had the propensity to possess high levels of acetone in their breath and that this could be detected as ethanol on a breathalyzer device. While 21 (39.6%) respondents who had a breathalyzer test done, claimed that the law enforcement officers (police) had explained to them the reason and purpose of such tests, 42.9% of the type 1 diabetics said that they did not know about this, nor did they remember (19%) their results.

Of the 14 (26.4%) respondents of type 2 diabetes mellitus, eight (57.14%), having failed the breathalyzer test, were subjected to a blood test. Four (4) of these had evidence of alcohol consumption; but however below the intoxication level. The other four (4) respondents pleaded guilty to alcohol consumption [Table/Fig-3]. Further, 52.4% of the type 1 diabetics who were subjected to a breathalyzer examination were charged and they faced the court for being accused of DUI/DWI, 9% of whom pleaded guilty, claiming to be frustrated of trying to convince the authorities that he/she had not consumed alcohol for the reason of being on diabetic medication and that this was against the advice of his/her physician. However, the court ruled a guilty verdict on 52.4% of the type 1 and 50% of the type 2 diabetics who had done the breathalyzer and the blood tests respectively.

Variable	Number	Percent
Physiological		
Did not eat (felt very hungry)	12	50
Ate in ≤ 1 hour	5	20.8
Ate in 2-4 hours	5	20.8
Ate in ≤5 hours	2	8.3
40-59	20	37.8
Equilibrium		
Stable	9	37.5
Wobbly	10	41.7
Faintish/Dizzy	5	20.8

[Table/Fig-2]: Type 1 diabetic respondent's condition prior to breathalyzer χ^2 = 0.75

Variable	Charged for DUI/DWI Number	Percent
Status of diabetic mellitus		
Type 1	11	52.4
Type 2	4	50
Pleaded guilty to DUI/DWI charge		
Type 1	1	9.1
Type 2	0	0
Court's guilty verdict		
Type 1	11	52.4
Type 2	4	50
Breathalyzer reading (>35mg/110 ml of breath)		

[Table/Fig-3]: Diabetic status versus cause for DUI/DWI allegation χ^2 = 0.35; C = 0.677** α = 0.01; p<0.01; Cramer's V = 0.725.

The findings revealed a relationship and a high association between the individuals with type 1 diabetes and the failure of a breathalyzer examination (χ^2 = 0.35), resulting in a guilty verdict by the court (C = 0.677, p < 0.01, χ = 0.01), regardless of a not-guilty plea. Similarly, the respondents of the diabetes mellitus status were less likely to have consumed alcohol, let alone to be classified as a DUI/DWI under the law (C = 0.725, p<0.01).

DISCUSSION

A majority of the respondents who had type 1 diabetes mellitus were males, who showed wobbly disposition during the sobriety tests which were carried out by the police, when stopped for being DUI/DWI suspects or for regular security checks. The signs and symptoms of hypoglycaemia in type 1 diabetics include slurred speech, slow gait, impaired motor control, fumbling hand movements and mental confusion, staggering, drowsiness, flushed face, and disorientation. These are all symptoms of intoxication. Further, there was also a significant correlation between the respondents' unstable equilibrium and the period between their last meals, prior to a breathalyzer test. The majority of the respondents claimed to have been feeling hungry, having not consumed a meal many hours prior to the test. Type 1 diabetics who were experiencing symptoms that were very similar to alcohol intoxication were most likely to fail the field sobriety tests. The test involved an individual suspected of DUI being asked by the law enforcement officers to walk in a straight line, in an effort to assess and determine that individual's co-ordination, balance and impairment.

Diabetic ketoacidosis is an acute and potentially fatal complication of type 1 diabetes which is typically characterized by hyperglycaemia, metabolic acidosis and ketone bodies such as acetoacetate, betahydroxybutyrate and acetone. Acetone is one of the compounds that is detected on many breathalyzer instruments as ethanol. In intoxilyzers such as those which were used in this study, acetone is detected because it absorbs infrared energy in the 3.38 to 3.40 micron range, the same range where ethanol is found. Breath acetone is generally regarded as an indicator of a serious loss of metabolic control in DKA. Brick (1993) found that the acetone in the breath of an untreated diabetic can contribute to erroneously high BAC [10]. In another study by Mormann et al., diabetic subjects were found to have acetone levels which were sufficient to produce a BAC of 0.06 percent [11]. Further, none of the respondents in this study were cognizant that persons with type 1 diabetes mellitus had the propensity to possess high levels of acetone in their breath and as a result, this could be detected as ethanol on a breathalyzer device.

A key finding in this study was that of just over one-half of the type 1 diabetics who were subjected to a breathalyzer examination were charged and they faced the court for being accused of DUI/DWI. The court ruled a guilty verdict on just over one-half of type 1 and type 2 diabetics who had underdone the breathalyzer and the BAC tests. Approximately one-tenth of those who pleaded guilty claimed to be frustrated in attempting to convince the police authorities that they had not consumed alcohol for the reason of being on diabetic medication and that this was against the advice of their physician. There was also significant relationship between the individuals with

diabetic mellitus (mainly type 1) and with the failure of a breathalyzer examination, resulting in a guilty verdict by the court, regardless of a not-guilty plea by the defendants. In the United States of America, it is a misdemeanor for an individual to drive a vehicle with a BAC of 0.08% or higher (0.02% in most states for drivers under 21) [12].

The breathalyzer provided the law enforcement officers with a non-invasive test, providing immediate results to determine a motorist's BAC at the time of testing. Most handheld breathalyzers use a silicon oxide sensor to determine the BAC. It does not however determine an individual's level of intoxication, as this varies by a subject's individual alcohol tolerance. The BAC can vary between individuals who consume identical amounts of alcohol, due to gender, weight and genetic pre-disposition [13]. There are limitations with the BAC testing, such as the lack of specific, as thousands of organic molecules such as acetone that contain the methyl group and the corresponding carbon-hydrogen bond absorb the light producing false positives. Intoxilyzers are well known to have specificity difficulties which distinguish between ethanol and other similarly sized molecules, which can result in high false positives due to the large amount of substances having the same wavelength interference as ethanol [14, 15]. Further, breathalyzers are very sensitive to temperature and will give false readings if not adjusted or recalibrated to account for the ambient or surrounding air temperatures. The temperature of the subject is also very important. The failure of the law enforcement officers in using the devices properly or of the administrators in having the machines properly maintained and re-calibrated as required, are the particularly common sources of error [16]. Improper software calibration affects the accuracy of the sensor of the breathalyzer, which degrades over time and with repeated use [17].

This study possesses the potential to provide scope for policy and legislative directions in Jamaica, relating to a more detailed and scientific analysis of a type 1 diabetic, who may be wrongfully charged for DUI and DWI. Through this study, law enforcement officers will be sensitized on the matter of the acetone in the breath of a genuine DUI, DWI and a type 1 diabetic. This could result in the kind of questions that they would ask a civilian, as well as the confirmation of an individual's BAC or diabetic status via a blood test.

CONCLUSION

This study showed that some individuals with type 1 diabetes mellitus, who were subjected to a breathalyzer examination, were charged and that they faced the court for being accused of DUI/DWI. Neither the police nor the type 1 diabetics in this study were cognizant of the fact that elevated acetone levels in patients with type 1 diabetes could cause increased BAC levels. This resulted in a wrongful conviction.

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