

# Alcohol, Tobacco, and Drug Use and the Onset of Type 2 Diabetes Among Inner-city Minority Patients

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**Background:** We examined the prevalence of alcohol, tobacco, and drug use and their relation to the age of onset of type 2 diabetes among inner-city minority diabetic patients who sought routine care at medical clinics in south central Los Angeles.

**Methods:** A cross-sectional study design was used to sample 392 diabetic patients. Consecutive patients from seven different primary care clinics were interviewed to determine their alcohol, tobacco, and drug use histories and the age of onset of diabetes.

**Results:** The study sample was 61% Hispanic and 64% female and had a mean age of 53 years. Seventy-one diabetic patients (18%) reported that they recently consumed alcohol. Sixty-nine patients (17%) reported smoking within 30 days of their interview. Thirty-eight diabetic patients reported a history of regular illicit drug use. Multiple regression analysis showed that diabetic patients who used alcohol, illicit drugs, or combined substances (alcohol and illicit drugs), but not tobacco alone, reported an earlier onset of type 2 diabetes.

**Conclusions:** This hypothesis-generating study suggests that alcohol and illicit drugs, when used alone or in combination, might be associated with an earlier onset of type 2 diabetes. Additional research, however, is required to evaluate further these preliminary findings. (J Am Board Fam Pract 2001;14:430–6.)

Diabetes mellitus is a chronic medical disorder known to be common among poor, ethnic minority populations.<sup>1</sup> Primary care physicians who treat these patients are obliged to recognize and minimize, if possible, risk factors for the disease and its complications. Recently, some investigators have described substance use, particularly alcohol and tobacco use, as a possible risk factor related to the development of type 2 diabetes in some patients.

Tsumura and colleagues<sup>2</sup> observed a large cohort of Japanese men (6,362) and found that heavy alcohol use among lean men was associated with an increased risk of type 2 diabetes. Likewise, Holbrook et al<sup>3</sup> examined 524 adult diabetic patients and found that alcohol intake was a risk factor for the development of non-insulin-dependent diabe-

tes mellitus in men, but not women. Lindegard and Langman<sup>4</sup> also found a positive correlation between alcoholism and the prevalence of diabetes. This issue remains unresolved, however, because other investigators have failed to confirm a link between alcohol use and diabetes.<sup>5–7</sup> In addition, the aforementioned studies also failed to examine the relation between alcohol use and the age of onset of the disease.

As previously mentioned, tobacco use (smoking) might also be related to the development of type 2 diabetes. Wannamethee and colleagues<sup>8</sup> observed 7,142 men who had no history of coronary heart disease, stroke, or diabetes at baseline. After 15 years, they reported that the risk of the combined end point (death or having a heart attack, stroke, or diabetes) went up significantly with increasing smoking levels. Kawakami et al<sup>9</sup> also found that individuals who smoked 16 to 25 cigarettes per day had a 3.27 times higher risk of developing type 2 diabetes compared with those who never smoked. Furthermore, Rimm et al<sup>10</sup> documented an increased relative risk of 1.9 for developing diabetes among smokers in a cohort study of more than 41,000 male health professionals observed for a 6-year period.

Few studies have looked at illicit drug use in type 2 diabetic patients. To our knowledge, no studies

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have examined the relation between illicit drug use and the onset of the disease. Much of the existing literature related to diabetes and illicit drug use has focused on the effects of drugs on compliance with self-care behaviors or the development of complications.<sup>11,12</sup> The patients in these studies had mainly type 1 diabetes, and thus it is uncertain whether their findings can be applied to adult type 2 diabetic patients, which are more frequently encountered in urban primary care settings.

This hypothesis-generating study should be viewed as an early step in the process of evaluating potential relations between substance abuse and diabetes onset. In addition to examining these relations, our goal was to estimate the prevalence of alcohol, tobacco, and illicit drugs use among type 2 diabetic patients in the inner-city primary care setting.

## Methods

### *Study Participants*

Consecutive diabetic patients who entered seven primary care clinics in the South Central Los Angeles area for routine care were invited to participate. The sites included three county and four private clinics, all of which served low-income minority patients. Study personnel screened diabetic patients for eligibility while they waited for their routine medical office visits. All patients with type 2 diabetes previously diagnosed clinically by their primary care physicians were evaluated for inclusion into the study. Self-report of diabetes status was confirmed by a review of the patients medical records. Informed consent of all eligible participants was obtained according to the policies and procedures specified by the King/Drew Medical Center Committee for the Protection of Human Rights.

### *Exclusion Criteria*

Patients were excluded from the study if they were taking medications (other than insulin or oral hypoglycemics) that were known to alter carbohydrate metabolism (eg, glucocorticoids,  $\beta$  blockers), had medical conditions that were known to alter hemoglobin A<sub>1c</sub> levels (eg, chronic renal failure, acute blood loss, hemolytic anemia), or if they were pregnant. Some items in the above-listed criteria were selected because data for the current study were collected concurrently with that from another

study<sup>13</sup> on the effects of alcohol consumption on glycemic control and compliance in type 2 diabetic patients.

### *Instrument*

Interviews took place immediately after each patient's visit with his or her primary care physician. Those patients who could not stay at that time were rescheduled for the interview within 1 month. Interviews were administered by trained study personnel and took approximately 30 to 40 minutes to complete. The study instrument consisted of about 78 items. The initial section of the instrument contained basic questions related to sociodemographic factors, health behaviors, and beliefs. In the next section, alcohol consumption during the past month was determined using the timeline follow-back (TLFB) procedure.<sup>14</sup> As part of the TLFB technique, participants were asked to report their drinking habits retrospectively with the assistance of a calendar to enhance their recall (eg, key dates were determined). A visual aid was used to help participants define standard drink equivalents (1 standard drink = 12 oz of beer, 5 oz of wine, 1½ oz of hard liquor). The TLFB technique was pioneered by Sobell and colleagues<sup>15</sup> and is reported to have high reliability across multiple populations of drinkers.

Study participants who drank in the last 30 days also received an Alcohol Use Disorders Identification Test (AUDIT) to determine their likelihood of problem drinking.<sup>16</sup> For the purposes of this study, "problem drinking" was defined as scoring higher than 5 on the AUDIT questionnaire or consuming more than 14 drinks per week or binge drinking (more than 5 drinks per occasion for men, more than 3 drinks per occasion in women). The AUDIT, a hand-scored (10-item) screening questionnaire developed by the World Health Organization, contains 3 questions on the amount and frequency of alcohol use, 3 questions on alcohol dependence, and 4 on problems caused by alcohol. Questionnaires were available in English and Spanish and were administered by trained bilingual interviewers.

### *Data Analysis*

Bivariate analyses were conducted to determine the relation between the dependent variable (age of onset of diabetes) and the independent variables (alcohol use, problem drinking, tobacco use, and

illicit drug use). In addition, multiple logistic regression analyses were conducted to examine the independent impact of each substance use variable on onset of type 2 diabetes, adjusting for other potential confounding variables such as sex, ethnicity, education, and body mass index. The independent impact of alcohol, tobacco, drug, and combined substance use was tested in separate multiple regression equations. In each equation, sex, education, ethnicity, body mass index, and substance use were entered into the regression analysis on onset of type 2 diabetes. Separate multiple equations were used because the variables were strongly correlated. Because few non-Hispanics or Africans were in the study, they were excluded from the analyses.

## Results

Screening for the study began on 1 October 1998. A total of 503 diabetic patients were screened. Four hundred sixty-eight patients agreed (93%) to participate. The most common reason given for not participating was inadequate time. Three hundred ninety-two patients (78%) met all criteria for the study and completed their interviews. The sample was 64% female and had a mean age of 53 years (range = 20 to 89 years). The ethnicity of the participants was as follows: Hispanic 61%, African American 29%, Asian American 4.6%, and others groups 4.9%. Sixty-eight percent of the Hispanic participants were born in Mexico, 11% in El Salvador, 5% in the United States, and the remainder in other Central and South American countries. Twenty percent of study participants had immigrated to this country within the last 10 years. The alcohol, tobacco, and drug use behaviors, along with other baseline demographic characteristics of the 392 study subjects are documented in Table 1.

### Alcohol Use

Seventy-one diabetic patients (18%) reported that they drank an alcohol-containing beverage within the last month. Of those who drank, the mean weekly level of alcohol consumption was 5.1 drinks (standard deviation [SD] = 8.2, range = 0.25 – 41 drinks per week). Sixty-one percent of the diabetic drinkers were light drinkers (1 – 3 drinks per week), 31% were moderate drinkers (4 – 14 drinks per week) and 8% were heavy drinkers (>15 drinks per week). Twenty-eight diabetic drinkers (6%) re-

**Table 1. Background Characteristics of the Study Participants (n = 392).**

| Characteristic               | No.          | Percent |
|------------------------------|--------------|---------|
| Sex                          |              |         |
| Female                       | 251          | 63.9    |
| Male                         | 142          | 36.1    |
| Mean age (years)             | 53 (+/- 9.4) |         |
| Age at onset of diabetes     |              |         |
| 18-40 years                  |              | 29.3    |
| 41-50 years                  |              | 37.8    |
| 51-60 years                  |              | 27.0    |
| 60 years and older           |              | 5.9     |
| Time since onset of diabetes |              |         |
| 0-2 years                    |              | 27.0    |
| 3-5 years                    |              | 25.3    |
| 6-10 years                   |              | 24.7    |
| 11 years or more             |              | 23.0    |
| Ethnicity                    |              |         |
| African American             | 115          | 29.3    |
| Hispanic                     | 240          | 61.3    |
| Asian American               | 18           | 4.6     |
| Other                        | 19           | 4.9     |
| Education                    |              |         |
| <9 years                     | 198          | 29.3    |
| 9-12 years                   | 145          | 37.0    |
| College                      | 49           | 12.5    |
| Health care coverage         |              |         |
| ATP                          | 159          | 41.6    |
| GRP                          | 152          | 39.8    |
| Medical                      | 26           | 6.8     |
| Medicare                     | 10           | 2.6     |
| Cash                         | 34           | 8.9     |
| Drinking behavior            |              |         |
| Nondrinker                   | 321          | 81.9    |
| Non-problem drinker          | 37           | 9.4     |
| Problem drinker              | 34           | 8.7     |
| Smoking behavior             |              |         |
| Nonsmoker                    | 306          | 81.4    |
| Current smoker               | 70           | 17.8    |
| 1-5 cigarettes a day         | 38           | 10.1    |
| 6-15 cigarettes a day        | 19           | 5.1     |
| 16 cigarettes or more a day  | 13           | 3.5     |
| Drug use                     |              |         |
| Within last 30 days          | 10           | 2.7     |
| Ever used regularly          | 38           | 9.7     |

ATP = Ability to Pay Program, a health care program designed to provide medical coverage for indigent patients. Fees for services are adjusted to the patient's income using a sliding scale. GRP = General Relief Program, a health care program designed for Los Angeles County welfare recipients.

ported that they participated in at least one episode of binge drinking within the previous 30 days. The most of the alcohol consumers drank between

**Table 2. Substance Use History and the Age of Onset of Type 2 Diabetes**

| Substance | Groups              | No. | Mean Age of Onset (years) | Difference Compared with Nonusers (years) | 95% Confidence Interval of the Differences (years) |
|-----------|---------------------|-----|---------------------------|---|--|
| Alcohol   | Nondrinkers         | 321 | 46.7                      | —   | —  |
|           | Nonproblem drinkers | 37  | 45.2                      | 1.5                                       | NS   |
|           | Problem drinkers    | 34  | 42.1                      | 4.6*                                      | 1.2–7.9  |
| Tobacco   | Nonsmokers          | 306 | 46.6                      | —   | —  |
|           | Smokers             | 70  | 44.3                      | 2.4†                                      | 0.2–4.6  |
| Drugs     | Nonusers            | 354 | 46.8                      | —   | —  |
|           | Users               | 38  | 40.7                      | 6.1‡                                      | 2.9–9.3  |

\* $P < .05$ .† $P < .01$ .‡ $P < .001$ .

meals (57%). Only 12% of diabetic drinkers admitted to usually drinking alcohol with meals, as recommended by the American Diabetic Association.<sup>17</sup> Seventy-two percent of the participants interviewed believed that alcohol use could adversely effect blood glucose control.

#### **Tobacco Use**

Sixty-nine (17.8%) of the diabetic primary care patients reported smoking at least 1 cigarette during the previous 30 days. Most of the diabetic smokers smoked less than 1 pack per day. Of those who smoked, 38 (56%) averaged 1 to 5 cigarettes per day, 19 (28%) averaged 6 to 15 cigarettes per day, and 11 (16%) averaged 16 to 30 cigarettes per day. Fifty-four percent of diabetic participants who smoked were advised to cut down or stop smoking by their primary care physicians in the month before their interview.

#### **Drug Use**

When asked, "Have you ever regularly used drugs?" 38 (10%) of the diabetic primary care patients admitted to regularly using at least one illicit drug at some point during his or her life. Only 10 participants (3%) admitted to any drug use within 30 days of their interviews. The most common drugs regularly used were marijuana 26 (7%) and cocaine 22 (6%). Other illicit drugs (amphetamines, heroin, hallucinogens, and nonmedical inhalants) were regularly used by less than 3% of the diabetic study participants. Eighteen (47%) of those who regularly used drugs admitted to regularly using more than one illicit drug.

#### **Alcohol, Tobacco, and Drug Use and the Onset of Diabetes**

A history of substance use was a significant factor associated with earlier age of onset of type 2 diabetes (Table 2). A one-way-analysis of variance (F-test) showed that problem-drinking diabetic patients reported significantly earlier ages of disease onset (4.6 years earlier) compared with nondrinking diabetic patients. Analysis of our data by *t* test indicates indicate that there was no significant difference in the age of onset of diabetes between non-problem-drinkers and nondrinkers. The onset of type 2 diabetes among smokers was 2.4 years earlier than the onset of the disease in nonsmokers ( $t = 2.2$ ;  $P < .05$ ). Those participants who admitted to using one or more illicit drugs regularly in the past had an earlier onset of diabetes by 6.1 years ( $t = 3.8$ ,  $P < .01$ ).

The independent relation of each substance (alcohol, tobacco, and drug) and combined substances on the onset of type 2 diabetes, once all other possible confounding variables were controlled, was assessed by four separate multiple regression equations, as presented in Table 3. In the first equation (model A), alcohol use was included in the regression. For the second and third equations (models B and C), alcohol use was replaced by tobacco and drug use, respectively. For the fourth equation (model D) combined alcohol and drug use replaced individual substance use. Tobacco use was excluded from this model because of its lack of significant association to diabetes onset in previous models.

The data presented in Table 3, model A, indicate that onset of the type 2 diabetes is related to

**Table 3. Standardized Regression Coefficients (Beta) and Standard Errors (SE) for Four Multiple Regression Models Testing the Relation Between the Onset of Type 2 Diabetes and Alcohol, Tobacco, and Drug Use Among Inner-city Minority Patients (n = 355).**

| Variables                    | Model A |      | Model B |      | Model C |      | Model D |      |
|------------------------------|---------|------|---------|------|---------|------|---------|------|
|                              | Beta    | SE   | Beta    | SE   | Beta    | SE   | Beta    | SE   |
| Sex (male)                   | -.06    | 1.1  | -.09    | 1.1  | -.06    | 1.1  | -.04    | 1.1  |
| Ethnicity (African American) | .09     | 1.3  | .08     | 1.3  | .11     | 1.3  | .11     | 1.3  |
| Education (years)            | -.24    | 0.1* | -.25    | 0.1* | -.25    | 0.1* | -.24    | 0.1* |
| Body mass index              | -.13    | 0.1† | -.12    | 0.1† | -.12    | 0.1† | -.12    | 0.1† |
| Alcohol use                  | -.12    | 0.8* | —       | —    | —       | —    | —       | —    |
| Tobacco (yes)                | —       | —    | .05     | 1.4  | —       | —    | —       | —    |
| Drug abuse (yes)             | —       | —    | —       | —    | -.19    | 1.7* | —       | —    |
| Alcohol and drug use         | —       | —    | —       | —    | —       | —    | -.18    | 0.7* |
| Adjusted R <sup>2</sup>      | 8.9%    |      | .1%     |      | 10.8%   |      | 10.3%   |      |

Note: Several of the independent variables in the analysis are represented by dummy variables: sex (0 = female, 1 = male), ethnicity (0 = Hispanic, 1 = African American), tobacco (0 = nonsmokers, 1 = smokers within last 30 days), drug use (0 = nonusers, 1 = users). \**P* < .01. †*P* < .05.

alcohol use, education, and body mass index. Similarly, model C shows that the onset of type 2 diabetes is related to history of drug use and body mass index. The data presented in model B, however, indicate that once the other variables were held constant, tobacco no longer remained statistically a significant variable in the equation. In addition, model D shows that the onset of type 2 diabetes is related to the combined substance use (alcohol and illicit drugs) even after all other variables were held constant. In all models education and body mass index remained statistically significant correlates of onset of type 2 diabetes.

### Discussion

The results of our study concerning alcohol consumption are consistent with those of other investigators who have found that alcohol use might be related to the development of type 2 diabetes. Our data support the hypothesis that the onset of type 2 diabetes might occur earlier among drinkers. This relation persists when potential confounding variables are held constant. In addition, the bivariate analysis suggests that this association could be particularly strong for problem drinkers, who had an onset of diabetes 4.6 years earlier. Larger studies are needed to confirm our results and, if confirmed, to determine whether psychosocial, behavioral, or biochemical factors are responsible for the earlier age of onset among drinkers.

Only 18% of diabetic patients drank alcohol within 30 days of their interviews. Cox et al.<sup>18</sup>

reported that 40% of the diabetic patients that entered their diabetic specialty clinics were drinkers. Their figures for drinking are high compared with those from our sample. This discrepancy might be due to two important factors. First, there are significant sex differences between the two study populations. Our sample was 64% female compared with 100% male in the study by Cox et al. Men are known to be more likely to drink in the general population. The same was true for our diabetic study participants (33% of men versus 10% of women drank). Second, there are significant differences in the ethnicity of the two sample populations. In the Cox et al study, the diabetic patients were mainly African American (65%), whereas most of our participants were Hispanic American (61%). In our sample, African Americans were much more likely to drink (28%) when compared with Hispanic Americans (15%). When both sex and ethnicity are taken into account, the differences in prevalence of drinking among the study samples might be quite small. For example, the frequency of drinking among the mainly African American men in the Cox et al study was 40% compared with 46% among our African American male patients.

Seventeen percent of our patients smoked within 30 days of their interview. This finding is especially alarming in diabetic patients, because smoking is well known to contribute to the early development of cardiovascular complications. The multiple regression analysis, however, failed to support a link

between smoking and the onset of type 2 diabetes. These results are contrary to those of the aforementioned studies that specify tobacco usage as a possible risk factor.<sup>8-10</sup> This discrepancy could be because we measured only recent smoking behavior (previous 30 days). Thus, it is likely that our analysis did not include a large portion of diabetic patients with a past history of smoking. Many of these individuals might have quit smoking since having diabetes diagnosed. Moreover, most smokers in our sample were light smokers (56% averaged 1 to 5 cigarettes per day). It is possible that higher levels of tobacco consumption are required to show an association between smoking and diabetes onset. Clearly, more comprehensive studies are required to address this issue. In the meantime, primary care physicians are best advised to continue to make an extra effort to encourage all patients, especially those with risk factors for type 2 diabetes, to abstain from smoking.

Ten percent of diabetic patients interviewed admitted to a history of regular illicit drug use. Similarly, only (3%) admitted to using illicit drugs during the 30 days before their interview. This low rate of current use might not be surprising given the sex (64% female) and older age of our sample (53). Furthermore, that most of the study participants were regular patients in a primary care clinic could select against current illicit drug users. Illicit drug users might be much more likely to receive care in the emergency department or hospital setting (as previously described by White<sup>11</sup>) or they might forgo medical care all together. Larger population-based samples might therefore be required to describe more accurately the prevalence of illicit drug use among inner-city diabetic patients. To our knowledge, no previous study has reported a relation between illicit drug use and earlier age of onset of type 2 diabetes. This reported association must be confirmed by larger population-based studies. Future investigators might chose to observe prospectively those patients with risk factors for diabetes, such as family history, impaired glucose tolerance, and impaired fasting glucose, to compare the age onset of diabetes in illicit-drug-using and non-illicit-drug-using groups.

The results of this study suggest that all primary care physicians should be aware of the alcohol, tobacco, and drug use habits of all patients who are at risk for type 2 diabetes. If our results are confirmed, patients known to be substance users might

require earlier screening for type 2 diabetes. This earlier screening would be especially important considering that the disease frequently goes undetected for as long as 5 to 12 years after hyperglycemia develops.<sup>19</sup> If future investigators confirm our findings, proven techniques for decreasing substance use, such as the "brief physician intervention," can be applied to those substance users who are at risk for developing diabetes.<sup>20</sup> Family physicians should also be prepared to refer addicted substance users to an appropriate substance use treatment facility or program.

Our studies results must be interpreted with caution in light of the following study limitations. First, because all information on level of alcohol and substance use was obtained through self-report, it is possible that the actual substance use rates among diabetic patients were higher than those reported in this study. Future investigators should consider including confirmatory drug and alcohol testing or supporting interviews with family members in their protocols. Confirmation of drug and alcohol use was not possible in our study because of time and budgetary limitations. Second, the patients were asked to recall detailed drinking and drug use histories retrospectively. Recall errors might affect the accuracy of the resulting data, especially for those diabetic participants with memory deficits. It might be advisable for future investigators to observe cohorts of diabetic patients and record substance use habits prospectively. Third, only information on current alcohol and tobacco consumption was used in examining their relation to onset of diabetes. It is therefore likely that some patients who previously used alcohol or tobacco were excluded from our analysis. Furthermore, it is possible that patients with diabetes who lived longer were more likely to resume substance use. Despite these limitations, we believe that the hypotheses generated by these data can serve as a catalyst for other studies that will further define the relation between alcohol, tobacco, and illicit drug use and the onset of type 2 diabetes.

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