Alcohol Consumption and Compliance Among Inner-city Minority Patients With Type 2 Diabetes Mellitus

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Objective: To examine the relation between alcohol consumption and self-reported compliance with prescribed therapies for type 2 diabetes mellitus among underserved minority patients.

Design: Cross-sectional sampling of consecutive patients with diabetes was performed following routine visits to their primary care physicians. Interviewers measured compliance using the Summary of Diabetes Self-Care Questionnaire and alcohol use using the timeline followback method and the Alcohol Use Disorders Identification Test.

Setting: Seven inner-city medical clinics that provide primary care services to low-income residents of South Central Los Angeles, Calif.

Participants: A total of 392 ethnic minority patients (61% Hispanic, 29% African American) with type 2 diabetes mellitus.

Main Outcome Measures: Self-report compliance with prescribed diet, exercise, home glucose monitoring, medications, and outpatient follow-up.

Results: Drinking any alcohol-containing beverage within 30 days was associated with poorer adherence to prescribed dietary recommendations for the consumption of fiber (t = 2.4; P < .05), fat (t = 4.2; P < .01), sweets (t = 2.7; P < .01), and energy (calories) (t = 2.0; P < .05). Drinkers were also less likely to exercise for at least 20 minutes per day (t = 2.2; P < .05), comply with oral medication regimens (t = 4.6; P < .01), or attend outpatient follow-up visits (r = −0.11; P < .05). Alcohol use did not significantly alter compliance with home glucose monitoring, insulin use, or hemoglobin A1c levels, although there was a trend toward higher hemoglobin A1c levels among drinkers (11.0 vs 10.4). Multivariate analysis of the data demonstrates that when demographic characteristics, health care utilization, and other diabetes-related variables are held constant, the relation between alcohol use and dietary compliance remained significant.

Conclusion: Alcohol consumption may be associated with poorer compliance with recommendations for some self-care behaviors among inner-city minority patients with diabetes.

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Moderate alcohol consumption among primary care patients has gained acceptance in the scientific community because of recent studies that clearly demonstrate its beneficial effects on the risk of coronary and cerebrovascular disease. These studies have focused on the physiologic and biochemical effects of alcohol and have led various organizations to generate recommendations for safe levels of alcohol consumption. One such organization, the American Diabetic Association, has recommended that men with diabetes drink no more that 2 drinks per day (woman, no more than 1 drink per day).

Furthermore, the American Diabetic Association recommends that alcohol should be consumed with meals to avoid alcohol-related hypoglycemia. These recommendations have been made despite the fact that relatively few studies have addressed the potential behavioral effects of moderate alcohol consumption on the patient with diabetes.

Alcohol intake is capable of altering patient behavior and thus potentially affecting patient compliance. This may be especially true for diabetic patients, since...
SUBJECTS AND METHODS

SUBJECTS

Diabetic patients who entered 7 primary care clinics in the South Central Los Angeles, Calif, area for routine care were invited to participate in the study. The sites included 3 county clinics and 4 managed care clinics, all of which served low-income, minority patients. Study personnel screened diabetic patients for study eligibility while the patients were waiting for their routine medical office visits. Study personnel used a brief screening questionnaire to identify diabetic patients who met the study criteria. All patients older than 18 years with clinically diagnosed type 2 diabetes mellitus were eligible for inclusion in the study.

EXCLUSION CRITERIA

Patients were excluded from the study if they were taking medications (other than insulin or oral hypoglycemics) that are known to alter carbohydrate metabolism (eg, glucocorticoids, β-blockers), if they had medical conditions that are known to alter hemoglobin A1c levels (eg, chronic renal failure, acute blood loss, hemolytic anemia), or if they were pregnant. Informed consent of all eligible subjects was obtained in writing following the policies and procedures specified by the King/Drew Medical Center’s Committee for the Protection of Human Rights.

DEFINITIONS

For the purposes of this study, drinkers were defined as subjects who drank at least 1 alcohol-containing beverage during the previous 30 days. Light drinkers were subjects who drank at least 1 drink during the previous 30 days but no more than 3 drinks per week. Moderate drinkers were defined as patients who consumed 4 to 14 drinks per week. Heavy drinkers were patients who consumed more than 14 drinks per week. Problem drinking was defined as scoring higher than 5 on the Alcohol Use Disorders Identification Test (AUDIT) questionnaire or consuming more than 14 drinks per week or binge drinking (>3 drinks per occasion for men and >3 drinks per occasion for women).

INTERVIEWS AND BLOOD SAMPLING

Study interviews took place immediately following each patient’s visit with their primary care physician, when possible. Subjects who could not stay at that time were rescheduled for the interview within 1 month. Interviews were administered by trained research assistants and took approximately 30 to 40 minutes to complete. Questionnaires were available in English and Spanish and were administered by trained bilingual interviewers. Baseline hemoglobin A1c levels were measured immediately following the completion of the interviews. In addition, research assistants reviewed the medical records of study participants and recorded the previous 3 documented hemoglobin A1c levels (when available). The mean hemoglobin A1c levels were calculated by combining the baseline measurements with the previously recorded values from the patient’s medical records.

INSTRUMENTS

The study instrument consisted of 78 items. The initial section of the interview questionnaire contained basic demographic and general health-related questions. Alcohol consumption during the past month was determined using the timeline followback procedure. As part of the timeline followback technique, subjects were asked to retrospectively report their drinking habits with the assistance of a calendar to enhance their recall (eg, key dates were identified). A visual aid was used to help subjects identify standard drink equivalents (1 standard drink=12 oz [360 mL] of beer, 5 oz [150 mL] of wine, or 1½ oz [45 mL] of hard liquor). The timeline followback technique was pioneered by Sobell and Sobell11 and is reported to have high reliability across multiple populations of drinkers.

All subjects who drank during the previous 30 days also received an AUDIT questionnaire to determine their likelihood of problem drinking.12 AUDIT is a hand-scored (10-item) screening questionnaire developed by the World Health Organization; it contains 3 questions on the amount and frequency of alcohol use, 3 questions on alcohol dependence, and 4 on problems caused by alcohol. Other questions on the beliefs and practices of diabetic patients who use alcohol were derived through a focus group that involved selected faculty members in the Department of Family Medicine, Charles R. Drew University of Medicine and Science, Los Angeles, Calif.

The Summary of Diabetes Self-Care Questionnaire was used to measure self-reported compliance. This 12-item instrument was developed by Toobert and Glasgow13 in 1989 and has documented internal consistency, concurrent validity, and test-retest reliability. The instrument contains questions related to compliance with diet (5 questions), exercise (3 questions), home glucose testing (2 questions), and medications (2 questions). Typically, the instrument is used to measure self-reported compliance during the previous 7 days. We modified the questions to query subjects about their compliance during the previous 30 days. This was necessary so that the period covered by the compliance-related questions would match that of the alcohol-related questions. The questionnaire was supplemented with several compliance-related items developed during focus group discussions among selected family practice faculty.
their therapeutic regimens require high levels of patient motivation, discipline, and close follow-up by health care professionals. More specifically, favorable outcomes among diabetic patients, in primary care settings, are frequently linked to each patient’s knowledge of and adherence to standard recommendations for lifestyle modification, medication use, home glucose monitoring, and medical follow-up. Thus, it is important to document the effects of alcohol consumption as they relate to the maintenance of these complex behaviors.

Investigators have examined a variety of factors as they relate to compliance in diabetic patients. Among these factors, increasing age, female sex, higher educational level, more years under care for diabetes, and certain specific behavioral patterns have all been identified as having a positive impact on compliance. Although greater numbers of medications, greater complexity of medication dosage scheduling, financial difficulties, transportation problems, forgetfulness, lack of time or interest, and lack of physician guidance have all been cited as impediments to compliance in diabetic patients.

The aforementioned studies on compliance in diabetic patients failed to address alcohol consumption as a possible factor. However, one recent study did look at the relation between alcohol use and treatment compliance in elderly men. In this study by Cox et al., it was reported that greater alcohol use was related to poorer compliance with insulin injections. This study also demonstrated a trend (although not statistically significant) toward lower levels of dietary and overall treatment compliance with increasing drinking levels. The applicability of these findings to a typical primary care setting is uncertain, since the study subjects were elderly men taken from a diabetes specialty clinic. In addition, this study did not examine the effect of alcohol on compliance with prescribed oral hypoglycemics or outpatient follow-up.

The present study was designed to reexamine the relation between drinking and compliance in diabetic patients. This study is unique in that it was carried out in a primary care clinical setting with a poor ethnic minority patient population. The results of this study will provide baseline information on the behavioral correlates of alcohol consumption among diabetic patients. In addition, this study’s findings will contribute significantly to our understanding of the effects of moderate levels of alcohol consumption on compliance with the standard recommendations for self-care behaviors among underserved minority diabetic patients.

**RESULTS**

**GENERAL CHARACTERISTICS OF THE SAMPLE**

Screening for the study began on October 1, 1998. A total of 503 diabetic patients were screened from all 7 centers. A total of 468 patients (93%) agreed to participate. The most common reason given for nonparticipation was inadequate time. A total of 392 subjects (84%) agreed to participate, met all criteria for the study, and completed their interviews.

**DEMOGRAPHICS**

The mean age of study participants was 53 years (range, 20-89 years). The ethnicity of the participants was as follows: 61% Hispanic, 29% African American, 5% Asian American, and 5% other groups. Twenty percent of subjects had immigrated to this country within the last 10 years. Sixty-eight percent of the Hispanic subjects were born in Mexico, 11% in El Salvador, 5% in the United States, and the remainder in other Latin American nations. Only 20% of those questioned had completed high school. The majority of subjects (55%) had at least completed elementary school. Eighty-five percent of study participants were unemployed at the time of their interview. Forty-one percent paid for health care services through the County of Los Angeles Ability to Pay program. The Ability to Pay program allows participants to pay for services using a sliding scale to adjust monthly payments to the patient’s income. Table 1 displays the means, percentages, SDs, and ranges of the demographic variables and other selected variables used in this study.

**COMPLIANCE RELATED TO DEMOGRAPHIC CHARACTERISTICS**

Bivariate relations among demographic variables (age, sex, ethnicity, education) and compliance with self-care behaviors were analyzed. Age was a significant factor related to dietary and medication compliance. Younger patients were less likely to follow their recommended diets; they consumed less fiber (r = 0.13; P < 0.01), more fat (r = -0.21; P < 0.01), and more sweets (r = -0.15; P < 0.01). In addition, younger patients were less likely to follow their oral medication regimen (r = -0.21; P < 0.01). No connection between sex and compliance with self-care behavior variables was detected. Significant differences were noted among ethnic groups in the area of dietary compliance. African American patients reported a higher dietary intake of fat-containing foods (t = 3.2; P < 0.01) and sweets (t = 3.2; P < 0.01). Furthermore, African Americans were more likely to comply with home glucose monitoring (t = 5.3; P < 0.01). Finally, the patient’s level of education was also a significant variable related to compliance. Patients with lower levels of education were more likely to consume fat (r = 0.2; P < 0.01) and sweets (r = 0.19; P < 0.01) and less likely to comply with home glucose monitoring (r = 0.22; P < 0.01).
DIETARY COMPLIANCE

Dietary compliance was compared in drinking and nondrinking diabetic patients (Table 2). Drinking patients reported that they were less likely to follow their recommended diets (during the previous 30 days) when compared to their nondrinking counterparts. Specifically, their diets were less likely to include foods high in fiber, such as fresh fruits, fresh vegetables, whole grain breads, dried beans and peas, or bran ($t = 2.4; P < .05$). In addition, their diets were more likely to include high-fat foods, such as butter, ice cream, deep-fried foods, and meats with fat or skin ($t = 4.2; P < .001$). Furthermore, the meals of drinking patients, during the 30 days before the interview, included a higher percentage of sweets and desserts ($t = 2.7; P < .01$). Drinkers also were less likely to successfully limit their energy intake as recommended by their physicians ($t = 2.0; P < .05$). When all dietary measures on the Summary of Diabetes Self-Care Activities questionnaire were combined, the relation between poor diet and alcohol consumption remained statistically significant ($t = 4.5; P < .001$).

COMPLIANCE WITH MEDICATIONS

There was no significant difference between drinking and nondrinking patients as to compliance with prescribed insulin (Table 2). However, drinkers reported lower compliance with oral medication use ($t = 4.6; P < .001$). Based on self-reported compliance scale where 1 indicates complied with all of the recommended pills and/or injections, 4 = complied with none of the recommended pills and/or injections. Poor dietary compliance was present in both subgroups of drinkers (nonproblem and problem) when compared with nondrinkers. Dietary compliance among drinking subgroups was not significantly different. However, an inverse linear trend was noted when the level of alcohol consumption was compared with compliance with most dietary variables (fat, energy intake, and fiber). For example, the percentage of meals with high-fiber foods among nondrinkers, non–problem drinkers, and problem drinkers was 59%, 52%, and 47%, respectively. Compliance with recommendations for the intake of sweets was also worse among drinkers. However, in this case, non–problem drinkers reported consuming more meals containing sweets (33%) compared with both nondrinkers (22%) and problem drinkers (28%).
subjects reported that they rarely experienced adverse effects from their insulin or oral hypoglycemic use. Surprisingly, non–problem drinkers reported significantly fewer adverse effects when compared with both nondrinkers and problem drinkers (F = 3.2; P < .05).

COMPLIANCE WITH OTHER SELF-CARE BEHAVIORS

Drinking diabetic patients reported that they exercised (for at least 20 minutes) fewer days than nondrinkers (14.4 vs 17.6 days; t = 2.2; P < .05). In addition, there was a negative correlation between the level of alcohol consumption (average number of drinks consumed per week) and the number of outpatient visits to ambulatory care clinics during the previous year (r = −0.11, P < .05) (which only accounts for <3% of the differences). However, the frequency of home blood glucose testing was not significantly different among the groups. Overall, there was a trend toward higher mean hemoglobin A1c levels among drinking diabetic patients when compared with nondrinking diabetic patients (11.0% vs 10.4%, P = .08).

MULTIVARIATE ANALYSIS

Multiple regression analysis was performed to examine the independent impact of alcohol consumption on the overall index of dietary compliance. Demographic characteristics (age, sex, education, and ethnicity), health care utilization (number of clinic and emergency department visits and hospitalizations within the last 12 months), diabetes-related medical and physical conditions (body mass index, duration of diabetes, presence of diabetes complications, hemoglobin A1c level), dietary prescription, smoking behavior, and alcohol consumption were all included in multiple regression analysis. To control for possible multicollinearity, the correlation among the independent variables was examined. The interrelations among the independent variables were modest, and no sign of harmful multicollinearity was detected.

Examination of the multiple regression analysis (stepwise method with probability of F-to-enter <.05 and F-to-remove >.10) reveals that only 5 variables were statistically significant (R² = 0.140, F = 11.64, P < .001): alcohol use, smoking behavior, number of outpatient visits, body mass index, and dietary referral. Table 3 shows the standardized coefficients (β), t and P values, and SEs of variables that remain significant in multiple regression analysis. These data show that when all other variables are held constant, the relation between alcohol consumption and poor compliance with diet remained statistically significant. In addition, diabetic patients were less likely to comply with their diets if they (1) smoked within the past 30 days, (2) had higher body mass indexes, (3) had a lower number of outpatient visits within the past 12 months, and (4) did not receive a specific dietary plan from their physician or a dietitian.

Investigators have identified a wide range of factors as potential correlates of dietary compliance. Few of these factors appear to be consistently noted and identified across different study populations. Therefore, it appears clear that dietary noncompliance is a complex multifactorial problem. Now add alcohol consumption to this mix. As previously mentioned, Cox et al.10 in 1996 described a trend toward poorer dietary compliance in their population of drinking diabetic patients. In addition, our results show a statistically significant relation between alcohol consumption and poorer compliance with dietary recommendations in specific areas (fiber, fat, sweets) and overall.

Both subgroups of drinking patients (nonproblem and problem) appeared to display poorer dietary compliance when compared with nondrinkers. Although the compliance differences between the subgroups was not significant, there was an inverse linear trend noted when comparing the level of alcohol consumption to compliance with most dietary variables (fat, energy intake, and fiber). This finding suggests that even nonproblem drinking may have the potential to negatively influence dietary compliance. This potential should be seriously considered by clinicians when evaluating the appropriateness of moderate alcohol consumption among their minority patients with type 2 diabetes.

Recent studies have documented a decreased risk of coronary events in diabetic patients who drink alcohol at moderate levels. Our study did not investigate the possible beneficial impact of moderate drinking on coronary heart disease among diabetic patients. However, it is conceivable that some of the coronary benefits derived from moderate drinking may be offset by its negative impact on compliance. Larger, more comprehensive studies are required to resolve this issue.

Table 3. Standardized Multiple Regression Coefficients for Significant Independent Predictors of the Overall Index of Diabetes Dietary Compliance*

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>β</th>
<th>SE</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol use</td>
<td>−0.191</td>
<td>0.47</td>
<td>−3.77</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Smoking behavior</td>
<td>−0.156</td>
<td>0.49</td>
<td>−3.07</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Body mass index</td>
<td>−0.144</td>
<td>0.03</td>
<td>−2.93</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>No. of outpatient visits</td>
<td>0.131</td>
<td>0.03</td>
<td>2.66</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>Prescribed a dietary plan</td>
<td>−0.157</td>
<td>0.39</td>
<td>−3.20</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

* Adjusted R² = 0.140. N = 392.
Perhaps alcohol consumption is associated with a dampening of impulse control among the diabetic patients. Another possible explanation could be that alcohol consumption might somehow be linked to the craving for particular types of foods. Alternatively, alcohol consumption might simply be a marker for patients who generally are less likely to practice the recommended self-care behaviors. This concept is supported by the fact that alcohol consumers reported fewer days of cardiovascular exercise, fewer outpatient clinical visits, and a tendency toward lower levels of compliance with prescribed oral medications. However, our study did not clearly demonstrate an association between alcohol and noncompliance in other important areas of self-care behavior (ie, insulin injections, home glucose monitoring). Larger studies are needed to confirm and clarify our results.

The results of our multivariate analysis also highlight the importance of ensuring that each patient receives a specific dietary plan from a physician or dietitian. As expected, diabetic patients who did not receive such a plan were less likely to adhere to dietary recommendations. These results are consistent with those of a study by Travis, who also identified the use of a dietary plan as a significant correlate of dietary adherence.

Our study’s results suggest that alcohol consumption may be associated with less frequent cardiovascular exercise among minority patients with diabetes. However, a recent study by Summerson et al reported no significant differences between exercising and nonexercising groups regarding their levels of alcohol consumption. Exercise is well known to have beneficial effects, including the facilitation of glucose utilization as the main source of energy for contracting muscles and decreasing peripheral insulin resistance in diabetic patients. Furthermore, some individuals with diabetes may already be less likely to exercise regularly when compared with people without the disease. Further studies are needed to clarify the issue.

The negative correlation between level of alcohol consumption and the frequency of outpatient visits in our diabetic population, although modest, is consistent with the findings of other investigators who have looked at the relation between alcohol and health services utilization in the general population. Armstrong and colleagues measured the utilization of health care services among a general population of health maintenance organization (HMO) patients and also found an inverse relation between alcohol consumption and the frequency of outpatient visits. They have suggested that this lower utilization of primary care services may result from a possible inattention to health problems among the heavier drinkers. In addition, recent studies by Cherpitel also suggest that HMO patients who come to primary care clinics are less likely to report heavy or problem alcohol consumption compared with HMO patients in the general population.

Finally, our study’s results must be interpreted with caution because of the following study limitations. First, our sample size did not allow sufficient power to analyze differences in compliance between subgroups of drinkers (eg, light, moderate, and heavy drinkers). This information will obviously be important to make the recommendations for safe alcohol consumption more specific. Second, all information on level of alcohol use was obtained through self-report. Therefore, it is likely that the actual alcohol use rates among diabetic patients are higher than those reported in this study. Future investigators should consider including confirmatory alcohol testing or supporting interviews with family members in their protocols. This was not possible in the present study because of time and budgetary limitations. Third, patients were asked to recall details about drinking retrospectively. It may be advisable for future investigators to follow cohorts of diabetic patients and record substance use habits prospectively. Despite these limitations, we believe that this study adds significantly to the growing body of data on alcohol consumption and its relation to the health of underserved minority patients with type 2 diabetes.

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