Acta Diabetol (2013) 50:93–99
DOI 10.1007/s00592-010-0200-x

REVIEW ARTICLE

Alcohol use of diabetes patients: the need for assessment and intervention

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Received: 4 December 2009 / Accepted: 17 May 2010 / Published online: 8 June 2010

Abstract It is well known that diabetes self-care behaviors are critical to disease progression. Unfortunately, many patients do not adhere to diabetes self-care recommendations despite their importance. Alcohol use has been identified as a barrier to diabetes self-care adherence. Excessive alcohol consumption not only negatively impacts diabetes self-care adherence but also affects the course of diabetes. Diabetes patients who are at-risk drinkers are likely to have poor diabetes treatment adherence, leading to increased morbidity and mortality. Alcohol consumption by diabetes patients is often inadequately assessed and addressed in their medical care. Brief interventions to reduce at-risk drinking have been well validated in a variety of patient populations and offer the potential to improve diabetes treatment adherence and outcome. Assessment and treatment of at-risk drinking could be readily incorporated into routine diabetes care. Strategies for brief assessment of and intervention for at-risk drinking are offered.

Keywords Alcohol use · Diabetes · Alcohol assessment · Brief intervention · At-risk drinking · Self-care adherence

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Introduction

Research has demonstrated that effective diabetes control requires patient adherence to treatment recommendations. Diabetes self-care behaviors including blood glucose monitoring, appropriate diet, and exercise have been shown to impact disease course; these self-care behaviors have been described as the cornerstone of diabetes treatment [1]. Unfortunately, adherence to diabetes self-care treatment recommendations is quite poor in both domestic and international samples. Only about one-quarter (26%) of type 2 diabetes patients in Mexico followed three important treatment recommendations: medication compliance, meal planning, and exercise [2]. In a sample of Finnish college students, only 19% reported "good" adherence to diabetes treatment recommendations [3]. Alcohol has been identified as one barrier to such limited adherence. In a study of college students with type 1 diabetes [4], glycemic control was impaired by alcohol use. Similarly, alcohol use was significantly associated with poor diabetes adherence among a sample of Finnish adolescents with insulin-dependent diabetes [3].

The impact of alcohol on diabetes self-care

Numerous factors may underlie the relationship between alcohol use and poor diabetes self-care. Alcohol consumption is associated with decreased food intake [5] and correlates with decreased willingness to adhere to dietary regimens [6]. It is thought that alcohol interferes with attention to diet and medication due to impaired judgment [6]; it may also impair other self-care behaviors such as exercise and glucose self-monitoring [7, 8]. Heavy drinkers with diabetes have poor insulin adherence and appear to

have decreased motivation to adhere to treatment regimens [6]. Even moderate drinkers have demonstrated poor adherence. For instance, both heavy (an average of >1 drink/day for women; >2 drinks/day for men) and moderate drinkers (an average of ≤1 drink/day for women; ≤2 drinks/day for men) with diabetes were less likely to perform daily glucose self-monitoring and less likely to have medical provider visits, compared to non-drinkers even after controlling for relevant variables such as diabetes duration, health status, and insulin use [9].

This relationship between alcohol use and self-care behavior has been documented in a very large diabetes patient sample [1]. This diverse sample from multiple hospitals and outpatient clinics consisted of nearly 66,000 patients. Adherence to six important diabetes self-care behaviors [exercising, smoking, blood glucose self-monitoring, taking diabetes medications, following a healthy diet, and annual Hemoglobin A_{1c} (HbA1c) testing] were examined in relation to the frequency of alcohol consumption, usual alcohol consumption, and average daily alcohol consumption. The results indicated that more than half of these diabetes patients were current drinkers. As expected, the highest rates of additional morbidity were found among those who were heavy drinkers. Notably, a significant negative association between alcohol use and diabetes self-care behavior was found indicating that greater alcohol use was significantly associated with poorer diabetes treatment adherence. This relationship was demonstrated with all six of the diabetes self-care behaviors examined.

Importantly, research with primarily ethnic minority samples has yielded similar results. Alcohol use negatively affected diabetes self-care behaviors in a study of mostly Hispanic (61%) and African American (29%) diabetes patients [10]. Specifically, recent drinking was significantly associated with poor adherence to dietary, exercise, and medication recommendations. Further, alcohol use correlated with poorer attendance at follow-up appointments.

Alcohol use among diabetes patients has also been associated with the maintenance of poor glycemic control [11]. In a diabetes treatment clinic sample, patients with poor glycemic control identified the primary reason they attributed to their inadequate adherence and resulting poor glycemic control. Those participants who reported that alcohol use was the reason for their poor adherence were more likely to have unchanged high HbA1c levels at a 12-month follow-up compared to those whose reasons for poor adherence included a new diagnosis of diabetes (and thus, elevated HbA1c), poor diet adherence, a coexisting medical condition, or recent stress [11]. In contrast to those who identified alcohol use as the problem, these latter patients demonstrated a significant reduction in their elevated HbA1c levels at the 12-month follow-up. It was suggested that alcohol use is a more chronic issue compared to factors such as acclimation to a new diagnosis of diabetes or a temporarily elevated HbA1c due to a "flare up" in a comorbid condition such as asthma.

The direct effect of alcohol consumption on diabetes

The diabetes and alcohol relationship is complex; the short-term impact of alcohol use on diabetes has yielded conflicting results. Differences among studies, such as whether alcohol is administered with or without a meal and whether a fasting glucose level is measured make comparisons across studies difficult [7] and may partially explain inconsistencies. Both glycemic control and glucose production have been shown to be affected by alcohol [5, 12]. Alcohol may also induce hypoglycemia [13, 14]. Diabetic control may be negatively impacted by even small amounts of alcohol [6]. However, no acute effect of small doses of alcohol on plasma glucose or serum insulin has been documented in at least one study [15]. In addition, one study [16] found an inverse relationship between alcohol consumption and HbA1c, a measure of past three-month glycemic control. However, data were collected using a lagged cross-sectional design; HbA1c was measured 1–2 years after self-reported alcohol rates were collected at baseline. As such, this time lag limits the conclusions that can be drawn. Last, in the presence of hypoglycemia, alcohol may increase diastolic blood pressure or exacerbate hypoglycemia-related cognitive deficits [17].

There is some evidence that modest alcohol consumption may have a beneficial long-term impact on diabetes course. For instance, diabetes participants who drank one glass of wine per day for a three-month study period had a lower fasting glucose level compared to abstainers [18], but there was no difference between groups in postprandial glucose levels. Similarly, diabetes patients who consumed 1–2 glasses of wine per day for a month had lower fasting serum insulin compared to a month-long period of abstinence. However, this was not associated with decreased glucose levels or HbA_{1c} relative to the period of abstinence [15]. A meta-analysis examining the relationship between alcohol use and coronary heart disease and mortality in type 2 diabetes found that rates of coronary heart disease and coronary heart mortality were significantly lower in all three categories of alcohol consumers (i.e., <6 g/day, 6- <18 g/day, and ≥18 g/day) compared to non-drinkers [19]. In addition, non-drinkers had a greater risk of total mortality when compared to the lightest drinking group, although not when compared to the heavier drinking groups. However, even the heaviest drinking category examined included modest drinking rates. That is, the highest drinking category examined in this study was greater than 1.5 drinks per day, which is not high enough to be considered "at-risk" drinking (for men) according to National Institute for Alcohol Abuse and Alcoholism (NIAAA) standards ([20]: ≥5 drinks on one occasion or >14

drinks/week for men and ≥4 drinks on one occasion or >7 drinks/week for women). Similarly, frequency and quantity of alcohol use were inversely associated with the risk of developing coronary artery disease among postmenopausal women with diabetes [21]. However, the drinking categories examined in this study were significantly lower than NIAAA cutoffs for at-risk drinking (i.e., >0 to <0.5, 0.5 to <2, and ≥2 drinks/week). In contrast to the effects of low-level alcohol consumption, drinking rates that exceed relatively low levels have been associated with greater risk of total mortality and greater risk of coronary heart mortality among diabetics [19, 22]. Further, diabetic neuropathy and retinopathy are correlated with heavy alcohol use (e.g., [14, 23]). Alcohol has led to problems with neuroendocrine, gastrointestinal, and sexual functioning [6]. In addition, heavy drinkers and non-drinkers had greater rates of atherosclerosis relative to light drinkers [24]. Research has also shown that heavy alcohol use may increase risk for hepatocellular carcinoma through its interaction with diabetes [25].

In addition to the direct effects on diabetes, negative interactions between alcohol and diabetes medications have been documented. For instance, the likelihood that alcohol will induce hypoglycemia is greater in the presence of sulphonylureas [14]. Also, chlorpropamide has been shown to reduce the rate of ethanol elimination from the blood [26]. Further, it is recommended that alcohol not be used excessively when taking metformin [27] due to increased risk for developing lactic acidosis.

Diabetes and alcohol problems

Diabetes commonly co-occurs with alcohol abuse or dependence. The incidence rates for medical conditions including diabetes, hypertension, and stroke are significantly greater among those with alcohol or drug problems compared to matched controls [28]. For instance, the results of one study demonstrated that 17% of diabetes patients seeking treatment for severe hypoglycemia had been drinking and 31% had been using some type of drug or alcohol [29]. Such high rates of comorbid diabetes and alcohol problems have also been found with adolescent samples. An investigation of the drinking habits of adolescents at a diabetes camp [30] indicated that 24% of the campers had abnormal modified Michigan Alcohol Screening Test scores. Rates were as high as 40–50% among 12 and 16 year olds.

Alcohol abuse or dependence among diabetes patients has been well documented within outpatient medical samples. In one sample, 28% of randomly selected diabetes patients met diagnostic criteria for a lifetime incidence of alcohol abuse, and 13% met either current (1%) or lifetime (12%) diagnostic criteria for alcohol dependence [31]. Among diabetes patients with comorbid hypertension, the rates of alcohol abuse and dependence were even higher; 38% met criteria for either current (3%) or lifetime (35%) alcohol abuse, and 16% met for either current (4%) or lifetime (12%) alcohol dependence [31]. Similarly, a study of veterans receiving medical care yielded a rate of 17.8% for those also receiving treatment for alcohol dependence [32]. For comparison, the 12-month prevalence of alcohol abuse among the general population is 4.65% [33]. In addition to alcohol abuse or dependence, at-risk drinking rates (i.e., ≥5 drinks on one occasion or >14 drinks/week for men; ≥4 drinks on one occasion or >7 drinks/week for women: [20]) among diabetes outpatients are significant. At-risk drinkers are those deemed likely to experience negative consequences as a result of their drinking and are at-risk for future alcohol problems. Engler and colleagues [34] found that 13.4% of diabetes patients in an outpatient medical clinic met criteria for current at-risk drinking. Among those at-risk drinkers, 11.1% met diagnostic criteria for current alcohol dependence. Although this rate of at-risk drinking is somewhat lower than that in the general population (30%: [20]), individuals with diabetes are vulnerable to experiencing certain medical consequences in addition to those associated with at-risk drinking within the general population (e.g., hypertension, gastrointestinal bleeding, sleep disorders, major depression, hemorrhagic stroke, cirrhosis of the liver, cancer; [35]).

Brief assessment of and intervention for at-risk drinking

The outpatient medical setting affords the ideal opportunity to assess at-risk drinking among diabetes patients. A number of brief questionnaires have been validated for identifying at-risk drinking or alcohol abuse or dependence. Such brief questionnaires could be easily incorporated into routine health surveys but may be too cumbersome for physicians to utilize in an interview format [36] or may not provide relevant information. For instance, the 4-item CAGE questionnaire [37] is widely used but assesses lifetime alcohol use disorders as opposed to at-risk drinking or even current alcohol use disorders [38]. The Alcohol Use Disorders Identification Test (AUDIT; [39]) identifies individuals with recent heavy drinking or alcohol dependence. However, its 10 items make it less feasible to imbed into health screening questionnaires or physician interviews [36]. To address this limitation, a briefer version of the AUDIT containing its three consumption items (AUDIT-C) has been utilized. This measure can be readily incorporated into health screening questionnaires. One limitation is that its binge drinking item reflects the NIAAA cutoff for men, which is greater than that for women. In addition, it has been argued

that the AUDIT-C's response options and scoring may be difficult for clinicians to remember [36]. However, at-risk drinking [20] can be readily evaluated in person by asking three questions about the typical quantity of alcohol consumed (using a gender specific cutoff for binge drinking) and the frequency with which it is consumed that are very similar to the AUDIT-C. (Please refer to Table 1 for sample questions.) As stated above, at-risk drinking refers to five or more drinks on one occasion or greater than 14 drinks/week for men and four or more drinks on one occasion or greater than seven drinks/week for women [20]. Therefore, any response reflecting at-risk drinking is considered a positive response; no special scoring is needed. Should drinking at levels greater than or equal to the at-risk drinking cutoffs be identified, treatment providers could implement a brief intervention, which is conducive to the outpatient medical setting. Brief interventions have been shown to be effective for at-risk drinking in addition to alcohol use disorders (e.g., [40]). Specific elements of brief interventions are discussed below.

Brief alcohol interventions are widely supported in the literature. A review [41] of alcohol abuse and dependence treatments found that brief intervention was one of only two treatments that met criteria for "efficacious" treatment. These findings have been supported in other reviews [42–45], and empirical support for the efficacy of brief interventions is widespread [46–55]. A recent meta-analysis examined 22 randomized controlled trials and 1-year drinking outcomes among primary care patients not seeking alcohol treatment [56]. The results revealed that participants who received brief alcohol interventions had significantly greater reductions than control participants and that lengthier interventions were not significantly better than brief interventions in reducing alcohol use. Interestingly, men benefited more than women from brief interventions; however, the authors suggest that there are insufficient data examining brief alcohol interventions among women specifically.

A component of brief interventions that lends itself well to the medical setting is brief advice. It has been shown that treatment providers who deliver brief advice at the time of an outpatient appointment are effective in reducing hazardous alcohol use. For instance, two 10- to 15-min physician-delivered interventions that contained educational elements and advice to reduce drinking have been successful among a group of non-alcohol treatment seeking heavy drinkers [49, 50]. This study resulted in significant reductions in mean number of drinks and frequency of excessive drinking during the previous 7 days and reduced binge drinking episodes during the previous 30 days. Furthermore, these findings were consistent at 6- and 12-month [50], as well as 48-month follow-ups [49].

Even briefer alcohol interventions show promise. For example, an intervention that was as brief as 5–10 min yielded significant results [52]. In this study, primary care providers provided non-alcohol treatment seeking patients with advice regarding drinking goals during routine medical appointments. The results revealed that, compared to control participants, high-risk drinkers receiving brief advice significantly reduced their alcohol use at a 6-month follow-up [52]. Advantages of brief interventions include their time and cost effectiveness. Indeed, some research has shown that there are no advantages of lengthier interventions. For instance, there were no significant differences in drinking outcomes between brief advice, a three-session intervention, or a seven-session intervention [57] as delivered by general practitioners for non-alcohol treatment seeking heavy drinkers. That is, there were no significant differences among intervention groups in several drinking-related outcomes including weekly drinking amount, drinking occasions per week, and usual drinking amount per occasion. These results held through a three-year follow-up.

Although there are some differences across interventions, brief interventions tend to contain similar elements [42]. Specifically, brief interventions typically entail fundamentals of the FRAMES acronym as described by Miller and Rollnick [58]. This includes the following: *F*eedback about one's drinking relative to the norm; *R*esponsibility for deciding to make change; *A*dvice to change or reduce drinking; a *M*enu of options for developing or implementing changes; *E*mpathy; and *S*elf-efficacy enhancement in order to facilitate successful change.

Despite the empirical support for brief interventions in the outpatient medical setting, the assessment of alcohol use and brief intervention do not often occur in clinical practice. Commonly reported barriers to alcohol intervention include limited time (e.g., [59]) and inadequate knowledge or training (e.g., [59, 60]). For instance, in a national survey of Veterans' Health Administration primary care clinics, the primary assessment and intervention barrier was a lack of time followed by concern about patient defensiveness [59]. Other barriers to intervening related to inadequate training or resources. Specifically, providers believed that interventions should be conducted by

Table 1 Sample questions to assess at-risk drinking

	Question
Frequency	"How often do you drink alcohol?"
Quantity	"When you do drink alcohol, how many drinks do you typically have?"
Binge drinking	Men: "How often do you have five or more drinks on one occasion?"
	Women: "How often do you have four or more drinks on one occasion?"

specialty staff and identified lack of specialty staff availability as a barrier as well as their own lack of knowledge or skill in conducting brief alcohol interventions. Facilitators to assessment included utilizing computers in the screening process, staff education, and having nurses or clerical staff complete the alcohol screener. In addition, a large percentage of respondents reported that increased supervision or quality management feedback would improve their rate of alcohol screening. Skill development training and practice, as well as feedback on specific patients, were identified as facilitators to both alcohol screening and intervention. In a European study [60], lack of familiarity with alcohol assessment tools and brief interventions were identified as barriers to assessment and brief treatment of alcohol use. In this Finish sample, only 20% of primary care physicians and nurses reported that they were familiar with brief structured questionnaires (e.g., CAGE), and only 18% reported that they knew the content of brief interventions well. Respondents ranked practical training, information about brief intervention research, and personal training among their top three facilitators to implementing brief intervention into routine medical care. Therefore, although brief alcohol assessment and intervention in the medical setting have been widely empirically supported, knowledge and training about brief alcohol assessment and interventions have not been adequately disseminated to practitioners in the medical setting. This includes knowledge of the efficacy of brief interventions including brief advice.

Brief alcohol interventions with diabetes patients

To date, there has been only one published study investigating the efficacy of a brief alcohol intervention with diabetes patients. Fleming and colleagues evaluated an intervention consisting of nurse-delivered brief advice split across two 15-min sessions and followed up by two 5-minute telephone calls [48]. In addition to the brief advice, the intervention involved providing feedback about test results of an alcohol biomarker, carbohydrate-deficient transferrin (CDT). Participants were outpatients who had type 2 diabetes, hypertension, or both type 2 diabetes and hypertension.

This intervention led to a significant change in the proportion of intervention participants who reduced heavy drinking and CDT levels from baseline to follow-up compared to the control participants. That is, in the intervention group, the proportion of heavy drinkers decreased to 24.7% at the 12-month follow-up from a rate of 35.8% at baseline compared to no change in the control group. This study supports the efficacy of brief alcohol interventions for diabetes patients in outpatient medical settings; however, it contains certain limitations that restrict the conclusions that can be drawn from the results. First, outcomes specific to diabetes, such as HbA1c and adherence to diabetes self-care behaviors, were not measured. As such, the effect of alcohol on diabetes variables and adherence behavior need further study. Second, several participants whose self-report of drinking did not match their CDT level were included in the study. That is, 41 participants reported drinking at lower than the "high risk" level that was a study inclusion criterion yet were still enrolled in the study despite this discrepancy. The authors report that the CDT test results could possibly be "false positives" and suggest that this is a study limitation. Third, study inclusion criteria did not reflect "at-risk" drinking as identified by established NIAAA guidelines [20] (i.e., $\geq$5 drinks on one occasion or >14 drinks/week for men; $\geq$4 drinks on one occasion or >7 drinks/week for women) but instead consisted of 50 or more drinks in the past 30 days for men and 30 or more drinks in the past 30 days for women. Fourth, the sample in this study combined diabetes and hypertension patients; therefore, it is difficult to identify the efficacy of the intervention on the diabetes patients specifically. Last, the specific effects of alcohol use on diabetes were not included in the intervention, which may have led to an even greater treatment effect. Future diabetes-related alcohol intervention research should include only diabetes samples to increase homogeneity, and diabetes-specific outcomes should be investigated. For instance, the effect of reduced alcohol consumption on HbA1c, triglycerides, and diabetes self-care behaviors such as exercise and blood glucose self-monitoring should be examined. In addition, NIAAA "at-risk" drinking cutoffs should be utilized in order to increase the generalizability of the results. Confidence in self-reported alcohol use could be maximized by using a collateral report from a participant's friend, family member, or significant other. Participants whose self-reported alcohol use is significantly discrepant from the collateral report (e.g., half of the sample standard deviation lower) could be eliminated from analyses to increase further confidence in the data. Finally, the impact of alcohol on diabetes should be incorporated into alcohol interventions with diabetes patient samples in order to maximize the efficacy of interventions with this population. Reviewing the implications of heavy alcohol use in the context diabetes may provide a "teachable moment" and enhance motivation for change.

Conclusions

Self-care adherence is a necessary component of successful diabetes treatment. Research has demonstrated that

self-care adherence is negatively impacted by alcohol use. In addition to its affect on self-care behavior, alcohol use may also negatively alter diabetes course leading to increased morbidity and mortality. At-risk drinking, as identified by the NIAAA, represents potentially problematic alcohol use. Outpatient medical appointments provide opportunities to assess and intervene with at-risk drinking among diabetes patients; however, the alcohol use of diabetes patients is not routinely assessed or addressed in this setting. Brief alcohol interventions are well validated in the outpatient medical setting with other patient populations and offer the potential to improve diabetes treatment adherence and outcomes. However, additional research examining the efficacy of brief alcohol interventions among patients with diabetes including the impact on diabetes-specific variables is needed. In addition, education regarding brief screening questions and the efficacy of very brief alcohol interventions should be disseminated to treatment providers so that such efficacious assessment and intervention will be implemented in practice to a greater degree.

Acknowledgments This work was supported in part by award number R01AA017418 from the National Institute on Alcohol Abuse and Alcoholism to S.E. Ramsey. The content is solely the responsibility of the authors and does not necessarily reflect the official views of the National Institute on Alcohol Abuse and Alcoholism or the National Institutes of Health.

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