RESEARCH REPORT

Predictive capacity of the AUDIT questionnaire for alcohol-related harm

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Abstract

The Alcohol Use Disorders Identification Test (AUDIT) is a 10-item questionnaire designed to screen for hazardous and harmful alcohol consumption. We examined its ability to predict alcohol-related illness and social problems, hospital admission and mortality over a 2–3-year period. At initial interview, 330 ambulatory care patients were assessed using a detailed interview including the AUDIT questions and laboratory tests. After 2–3 years, 250 (76%) subjects were reassessed and their experience of alcohol-related harm determined. Of those who scored eight or more on AUDIT at initial interview, 61% experienced alcohol-related social problems compared with 10% of those with lower scores (p < 0.0001); they also had a significantly greater experience of alcohol-related medical disorders and hospitalization. AUDIT score was a better predictor of social problems and of hypertension than laboratory markers. Its ability to predict other alcohol-related illnesses was similar to the laboratory tests. However, gamma glutamyltransferase was the only significant predictor of mortality. We conclude that AUDIT should prove a valuable tool in screening for hazardous and harmful alcohol consumption so that intervention can be provided to those at particular risk of adverse consequences.

Introduction

While people with hazardous or harmful alcohol use are more likely than the rest of the population to present to medical attention, their drinking problem often goes unrecognized. As few as 28% are known to their doctor as having a problem.[1,2] Indeed, of those who go on to become alcohol dependent, the majority do not seek help until there are established and often serious complications of their drinking.[3] Late diagnosis is of particular concern because there are now available effective and low-cost methods of treating problem drinking at an early stage.[4–7] Screening instruments such as the Michigan Alcoholism Screening Test (MAST)[8] and the CAGE[9,10] have proven to be effective in detecting the alcohol-dependent individual. However, there have been reports that they detect only 30–60% of problem drinkers in the community setting where the incidence of dependence is lower.[11,12]

In 1989 the World Health Organization (WHO) published a brief 10-item screening

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questionnaire, the Alcohol Use Disorders Identification Test (AUDIT).[13-15] This questionnaire was specifically designed to identify people with hazardous or harmful alcohol consumption before physical dependence or chronic physical or psychosocial problems had arisen. It was produced for use in primary health care settings and has questions on quantity and frequency of alcohol consumption, drinking behaviour and alcohol-related problems or reactions. Responses to each question are scored from to 4 and a total score of eight or more is taken to indicate hazardous or harmful alcohol consumption. In the sample of 913 people, from whose responses it was derived, AUDIT was reported to have a sensitivity of 92% and a specificity of 94% in detecting hazardous or harmful alcohol use.[14]

Since it was first published, AUDIT has been widely adopted as a screening instrument. It has been used either as a discrete questionnaire or incorporated into the standard medical history. Two studies have examined the reliability and concurrent validity of AUDIT. In both studies, minor modifications were made to the questionnaire; however, both showed it had good internal reliability with a Cronbach's alpha coefficient of 0.80–0.86.[16,17] AUDIT detected a higher proportion of problem drinkers than an existing questionnaire, the short Michigan Alcoholism Screening Test (SMAST)[18] in a primary health care setting.[17] In a third study AUDIT (in its unmodified form) was administered to Norwegians experiencing long-term unemployment.[19] Using a cut-off of 11 or more, the questionnaire detected 94% of those with DSM-III alcohol abuse or dependence and had a specificity of 85%.

The concurrent validity of a questionnaire can be compared against an expert clinical assessment, a diagnostic interview schedule or laboratory markers. All these are imperfect standards and subject to error of their own. Perhaps the most important measure is the predictive or longitudinal validity, the ability to predict adverse outcomes in a prospective study. In the Norwegian study above, those with AUDIT scores of 11 or more were more likely to be unemployed two years later (relative risk 2.6).[19] It is not yet reported whether AUDIT is able to predict other social complications of drinking, continued hazardous alcohol use, or medical disorders related to drinking.

In the present study we have examined the ability of the AUDIT questionnaire to predict which subjects experience medical or social harm from their drinking. We present data from a 2–3-year prospective study of 330 subjects.

Patients and methods

In 1984–85 we interviewed 350 patients who were attending the ambulatory care section of the Emergency Department of Royal Prince Alfred Hospital, Sydney.[20] Subjects not currently being attended by a medical officer were approached in sequence. There was an 11% refusal rate. After informed consent was obtained, each underwent a comprehensive assessment of medical history, alcohol consumption, dependence and related problems using the interview schedule developed for the WHO Collaborative Project on Identification and Treatment of Persons with Harmful Alcohol Consumption.[21,22] The schedule takes 60–90 minutes to administer and the AUDIT questions are interspersed among other items. Scores for alcohol intake on a typical day were derived from continuous data on consumption in the original schedule. Results of physical examination and laboratory tests, including gamma glutamyltransferase (GGT) and mean corpuscular volume (MCV) were recorded. The prevalence of hazardous alcohol consumption and related problems in these 350 subjects has been reported previously.[20] Of this group, 192 (55%) were interviewed as part of the WHO Collaborative Project.

At the end of the interview, subjects were asked permission to be contacted in 2–3 years' time; 12 subjects refused. Eight further subjects were excluded from the longitudinal study because of malignant disease which was present at initial interview. This left a cohort of 330 subjects, comprising 212 males and 118 females.

Follow-up assessment

Two hundred and fifty (76%) subjects were either re-interviewed (72%) or found to be deceased with cause of death known (4%).[23] As might be expected, those who were lost to follow-up were more likely to have reported hazardous alcohol intake at initial assessment.[23] Of those re-interviewed, 81% had a personal interview, 18% were interviewed by phone and 1% by mail. Interviewers were blind to the results of the initial assessment. Experience of alcohol-related physical and social problems, and the number of

hospitalizations and attendances for medical consultations in the period between interviews were recorded. The mean time between interviews was 32.2 ± 5.8 months ($\pm$ SD). The final part of the assessment involved inspection of subjects' medical records at Royal Prince Alfred Hospital. Records were found for all except three subjects. Each attendance was coded as to whether it was definitely or possibly related to alcohol by a registered nurse, using a list of diagnoses and situations compiled by the authors (criteria available on request). The coder was blind to the initial interview results.

Laboratory tests

Of the 330 subjects, nine had no liver enzyme results and six had missing MCV results. These subjects were excluded from analyses relating to those tests. GGT results were excluded in cases with biliary disease or liver disease with known cause other than alcohol; MCV results were excluded in subjects with anaemia or haemoglobinopathy. The laboratory reference ranges were for GGT 0–55 U/l and for MCV 76–96 fl.

Definitions

A score for medical disorders was computed by adding one point for each of the following experienced since the time of initial interview: liver disease, gastro-intestinal haemorrhage, head injury, road accident injury or fractures, hypertensive medication in the past week and elevated blood pressure ($\geqslant 140/90$)[24] at follow-up interview. These conditions were considered to be the ones most likely to be related to alcohol use in this population. Experience of trauma was assessed by asking if the subject had broken any bones, had a head injury, or been hurt in a road accident. A social problem scale was compiled from the following: friends or family concerned about drinking, employer or workmate concerned about drinking, work problems related to drinking and legal problems due to drinking. Each item contributed one point to the score.

For the purposes of this paper, hazardous alcohol intake is defined as drinking a daily average of more than 40 g for a man and more than 20 g for a woman. Frequent drinking likely to result in intoxication is defined as consumption twice a month or more often of 12 drinks per occasion for a man, or for a woman six drinks per occasion.

Analyses

The AUDIT questions were scored from 0 to 4 according to published guidelines.[13] Subjects who scored eight or more were classified as potentially hazardous drinkers.[14] AUDIT was examined for its ability to predict a number of endpoints. These included alcohol-related medical disorders, health care utilization, social problems and hazardous alcohol intake at the time of follow-up. The relative risk of each of these events was calculated for those scoring eight or more on AUDIT compared with those scoring below the cut-off. Linear multiple regression was performed to examine the relationships between AUDIT classification and health care utilization. Because scores for alcohol-related illnesses and social problems were too highly skewed to be satisfactorily transformed, they were dichotomized according to the presence or absence of harm and analysed using logistic regression.

Analyses were performed using the Statistical Package for the Social Sciences (SPSS for Windows, Version 6.0).[25] All values for relative risk quoted are statistically significant (the 95% confidence interval (CI) excludes 1.0), unless otherwise stated. Relative risk was calculated by comparing experiences over the 3-year follow-up period of subjects who initially had an elevated test result, mean daily intake above the limits of 40 g (male) and 20 g (female) or AUDIT score of eight or more with those whose values were below these levels.

Results

As reported previously, at initial interview 122 subjects (37%) scored 8 + on AUDIT and so were classified as presumptively having hazardous or harmful alcohol consumption.[15] This number was made up of 101 men and 21 women. AUDIT detected 94–97% of those with hazardous alcohol consumption and alcohol-related medical or social problems (specificity of 78–88%).[15] At the second assessment 120 subjects (84 men and 36 women) reported having an illness which could be related to alcohol over the follow-up period and 59 (51 men and

Table 1. *Relative risk of death, medical and social consequences and hospitalization in relation to laboratory test results, alcohol intake and AUDIT classification at recruitment*

Endpoint	Elevated marker†		Hazardous alcohol intake	AUDIT score ≥ 8
	GGT	MCV		
Death	4.4*	3.3	2.3	2.4
Liver disease or gastrointestinal bleed	4.0*	4.4*	2.5*	4.0*
Elevated blood pressure	1.2	0.9	1.9*	1.8*
Trauma	1.8*	3.3*	1.6	1.8*
One or more medical disorders which could be related to alcohol	1.5*	1.8*	1.7*	1.8*
Social problems related to alcohol	2.2*	2.3*	3.9*	5.9*
Hospital admission	1.5*	1.8*	1.4*	1.5*

†Result above the laboratory reference range.
*95% confidence interval excludes 1.0.

eight women) reported alcohol-related social problems.[23]

Prediction of medical disorders and social problems
Those who scored eight or more on AUDIT at initial interview were significantly more likely to experience social problems from drinking (60.9%) compared with those whose score was under eight (10.3%; $p < 0.0001$). Those with elevated AUDIT scores were also more likely to suffer from medical disorders which could be related to alcohol (73% compared with 41.6%; $p < 0.0001$).

The ability of AUDIT to predict death, and medical and social consequences was compared with other commonly used indicators of a drinking problem: standard laboratory tests (GGT and MCV) and estimate of alcohol intake (Table 1). AUDIT was the best predictor of alcohol-related social problems and had a similar ability to predict liver disease or gastrointestinal bleeding and trauma. It also was a significant predictor of elevated blood pressure at follow-up, whereas the markers were not. In contrast, elevated GGT was the only indicator associated with a significantly increased risk of death over the follow-up period.

Regression analysis was used to determine the effect of age and sex on the predictive ability of AUDIT. A high AUDIT score was a significant predictor of social problems using a logistic regression model (relative risk (RR) 13.54, CI 6.7–91.3). The strength of the association changed little when age and sex were controlled (RR 12.7; CI 2.7–27.4). AUDIT was also a significant predictor of medical disorders using a logistic regression model (RR 3.8; CI 2.0–6.9). Controlling for age and sex had little impact on the strength of the association (RR 3.2, CI 3.0–6.1). Even if GGT elevation was controlled for, AUDIT produced a significant improvement in prediction (RR 2.8, significance of improvement 0.002).

Prediction of hazardous consumption at follow-up
AUDIT score at initial interview was a better predictor of alcohol intake at the time of follow-up than were the laboratory markers or the initial assessment of alcohol intake. Those who scored eight or more on AUDIT were 6.6 times more likely to report drinking more than 40 g (men) or 20 g (women) per day at follow-up than those who scored less than eight. They were 6.9 times more likely to report frequent drinking likely to result in intoxication. By contrast, subjects with elevation of GGT and/or MCV were 2–3 times as likely to report intakes of that level. Those subjects who, at the initial interview, reported hazardous intake or frequent drinking likely to result in intoxication, were 4–5 times as likely to report intake at this level at follow-up compared with those who had a lower initial intake.

Prediction of hospitalization and attendances for medical care

Persons with an AUDIT score of eight or more were more likely to have been hospitalized over the follow-up period (RR 1.5, Table 2). They were also more likely to have had an attendance (RR 11.9, CI 4.3–33.2) or admission (RR 8.5, CI 1.9–38.2) to Royal Prince Alfred Hospital for a condition related to alcohol. AUDIT performed better than laboratory markers or intake assessment in this regard: subjects with elevated levels of either GGT or MCV had a 4.5 times increased risk of an alcohol-related attendance (CI 2.3–8.6) and a 3.7 times increased risk of an alcohol-related hospital admission (CI 1.2–11.1). Hazardous alcohol intake was associated with a 6.5 and 5.4 times increased risk, respectively (CI 2.0–21.0 and 2.8–10.6).

Discussion

In this study we have demonstrated that a brief 10-item screening questionnaire, AUDIT, is a significant predictor of alcohol-related social problems, illness and hospitalization. The AUDIT score was a better predictor of alcohol-related social problems, and of hazardous drinking at the time of follow-up than were blood tests or assessment of alcohol intake. It performed at least as well as standard blood tests (GGT and MCV) and a detailed alcohol intake assessment in predicting medical sequelae. However, GGT was the only measure associated with a significantly increased risk of death over the follow-up period. The ability of AUDIT to predict alcohol-related social problems and medical disorders was not affected by statistically controlling for age and sex of the subject. While AUDIT appears to be a useful predictor of alcohol-related medical disorders in women, these results must be interpreted with caution as the number of women with hazardous alcohol consumption at initial assessment was low.

Of those with an AUDIT score of eight or more at initial interview, 73% experienced a medical problem which could be related to alcohol and 61% experienced a social problem related to alcohol. Clearly, AUDIT has considerable potential in identifying drinkers at risk of harm from their drinking. Given the limited health care resources available for intervention, it may be argued that efforts should be concentrated on those who are especially likely to suffer adverse social and physical consequences of drinking.

There are relatively few instances where the capacity of a screening procedure to predict future harm has been determined. Among drink drive offenders there have been several studies on the ability of the Mortimer–Filkins Questionnaire[26] and other screening instruments to predict recidivism. In general their performance has been disappointing, with the Mortimer–Filkins Questionnaire explaining only 20% of the variance in recidivism. In Sweden, middle-aged men from the town of Malmö were screened using a questionnaire known as the Malmö modification of the Michigan Alcoholism Screening Test (MmMast); 3–8 years later MmMast score was found to correlate with incidence of death related to alcohol.[27] In a recent study of trauma victims, patients were assessed on admission to hospital using the SMAST and GGT.[28,29] Those who had results above the reference range in both were found to have twice the risk of experiencing a medical complication of their trauma, such as infection.[28] However, SMAST score on its own was not a significant predictor. Patients with elevated SMAST scores were 2.2 times more likely to be readmitted during the next 16–40 months, but this increase in risk became non-significant when demographic factors and mechanism of injury were controlled.[29] Recently AUDIT was examined in a group of Norwegian unemployed.[19] Those who scored 11 or more on AUDIT had a 2.6 times increased risk of being unemployed at follow-up interview 2 years later. This is in keeping with the finding of the present study, that AUDIT classification is a predictor of a number of adverse endpoints that are commonly associated with hazardous alcohol consumption.

Somewhat more data are available on the predictive capacity of laboratory tests. Elevated GGT levels (> 60–80 U/l) have been shown in two studies to be predictive of increased morbidity and 6–12 times increased mortality in a 3–5 year period following screening.[23,30] Indeed, GGT has been shown to be a better predictor of mortality in middle-aged men than serum cholesterol, smoking status or blood pressure.[27] MCV and aspartate aminotransferase (AST) levels have also been shown to be predictive of increased morbidity.[23] However, as AUDIT can be administered at negligible cost, and with immediate feedback of results, it offers con-

siderable advantage over biological markers in the front-line assessment of risk from drinking.

There may of course, be situations where biological markers are particularly useful, for example if a subject's history is unreliable or unavailable. It also should be noted that elevated GGT was the only measure to be associated with a significantly increased risk of death over the follow-up period in the present study. This probably reflects the fact that GGT is characteristically raised in persons with a long history of regular daily excessive drinking,[31] a pattern which is known to predispose to chronic alcohol-related disease. In contrast, AUDIT was designed to detect excessive consumption, but particularly those with lesser or more recent problems. The latter group would be expected to be at a lower risk of death. Given that AUDIT was not shown to be a significant predictor of mortality, it may be considered appropriate that in some settings, GGT be used as an adjunctive test to AUDIT. This would be considerably cheaper, and less invasive, than screening all subjects with GGT levels.

While assessment of alcohol intake in this study was almost as strong a predictor as the AUDIT score for several adverse endpoints, it must be noted that the procedure for assessing alcohol intake was complex and required trained interviewers. It was based on the WHO 'tri-level' method which takes approximately 20 minutes to administer.[22] This provides information on the type and amount of alcohol consumed on low, medium and high-level drinking occasions, and the frequency of these occasions in the last 30 days, and in a typical month. It is much more comprehensive than an interview conducted in a clinical setting could normally be. Although it provides detailed information, it is not a procedure which could be readily incorporated into a clinical assessment.

In summary, AUDIT is a brief and convenient questionnaire which can be self-administered or presented by a health care professional; it takes approximately 2 minutes to complete and score. Its questions can readily be incorporated into the standard medical history. It can detect 92% of people with hazardous alcohol consumption and has a specificity of 94%.[14] We have now demonstrated that it can predict a range of harmful consequences of alcohol consumption. It should prove a valuable tool in screening for hazardous and harmful alcohol intake so that intervention

can be provided to those at particular risk of adverse consequences.

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