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**Hazardous drinking prevalence and correlates in older New Zealanders: A comparison of the
AUDIT-C and the CARET**

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Author contribution:

A. Towers, D. A. L. Newcombe, and J. Sheridan planned the study. Á. Szabó performed the statistical analyses. A. Towers supervised the data analysis. A. Towers and Á. Szabó wrote the paper. D. A. L. Newcombe, J. Sheridan, A. A. Moore, M. Hyde, A. Britton, P. Martinez, N. Minicuci, P. Kowal, T. Clausen, and C. L. Savage contributed to the interpretation of the analyses and revising the paper.

**Hazardous drinking prevalence and correlates in older New Zealanders: A comparison of the
AUDIT-C and the CARET**

Abstract

Objectives: The study compared the proportion of older adults identified as drinking hazardously based on the Alcohol-Use Disorders Identification Test-Consumption (AUDIT-C) with the older adult-specific Comorbidity Alcohol Risk Evaluation Tool (CARET), and investigated whether socio-demographics, comorbidities, health, medication use, and alcohol-related risk behaviours explained discrepancies between the screens in classification of hazardousness.

Methods: The AUDIT-C and the CARET were administered to 3,673 adults aged 55-89 years. Classification agreement between the screens was evaluated using Cohen's kappa. Hazardous drinking groups were compared using logistic regression.

Results: Analysis indicated moderate agreement between the screens. Drinkers classified as 'hazardous on the CARET only' consumed less alcohol, but were more likely to drink-drive. Introducing a drink-driving criterion into the calculation of hazardousness on the AUDIT-C substantially decreased the classification discrepancy between the measures.

Discussion: Standard screening can be improved by investigating comorbidities, medication use, and alcohol-related risk behaviours in those initially identified as non-hazardous drinkers.

Keywords: alcohol, health care use, NZHWR, screening, SF-12

Hazardous drinking prevalence and correlates in older New Zealanders: A comparison of the AUDIT-C and the CARET

The World Health Organization defines hazardous drinking as “*a pattern of alcohol use that increases the risk of harmful consequences for the user or others*” (World Health Organization, 1994). Hazardous drinking is responsible for 5.1 % of the global burden of disease and injury (World Health Organization, 2015). In older adults (broadly defined as persons aged 60 years and older) specifically, hazardous drinking has been linked to faster cognitive decline (Topiwala et al., 2017), early work exit (Rice, Lang, Henley, & Melzer, 2011), and increased mortality risk (Knott, Coombs, Stamatakis, & Biddulph, 2015). In an era of rapid population ageing, an increasing number of older adults are drinking hazardously, i.e., at levels that increase risk for harm (Bosque-Prous et al., 2017; Knott et al., 2015) posing concern regarding whether health care systems have the capacity to cope with the likely health ramifications (Savage, 2014). Considering the costs avoided through primary healthcare detection and intervention (Solberg, Maciosek, & Edwards, 2008), timely identification of hazardous drinking in older adults is critical.

Compared to younger adults, older adults are more sensitive to the effects of alcohol because of age-related physiological processes that increase the negative effects of alcohol (e.g., lower amounts of total body water), are more likely to have developed health conditions associated with (or exacerbated by) alcohol use (e.g., gastroesophageal reflux), to use alcohol-interactive medications, and to be involved in alcohol-related accidents (e.g., falls) (Caputo et al., 2012). Despite being at heightened risk of alcohol-related harm, older adults who drink hazardously often remain undetected, creating what has been called a ‘hidden epidemic’ (Johnson, 2000). Problems with alcohol use present in ways that are often associated with the ageing process (e.g., accidents), which makes the detection of hazardous

drinking in this population more difficult (O'Connell, Chin, Cunningham, & Lawlor, 2003).

Failure to detect hazardous drinking among older adults has also been attributed to the use of screening tools developed and validated for younger age groups (Beullens & Aertgeerts, 2004; Fink, Tsai, et al., 2002).

The Alcohol Use Disorders Identification Test (AUDIT) and its abbreviated versions, most notably the AUDIT-C, are some of the most commonly employed screens for hazardous alcohol use (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Reinert & Allen, 2007).

Despite its utility for detecting hazardous levels of alcohol use in younger cohorts, the AUDIT is, by design, insensitive to comorbidities, co-occurring medication use, and other alcohol-related risk factors that might place older adults at increased risk of harm. Therefore, there is concern that using alcohol screens that are insensitive to risk factors specific to older adults results in inaccurate assessment of hazardous alcohol use in this population (Fink, Tsai, et al., 2002).

Recognising this issue, the *Alcohol Related Problems Survey* (ARPS) (Fink, Morton, et al., 2002; Fink, Tsai, et al., 2002; Moore, Hays, Reuben, & Beck, 2000) and its brief version, the *Comorbidity Alcohol Risk Evaluation Tool* (CARET) (Moore, Beck, Babor, Hays, & Reuben, 2002; Moore et al., 2006) were developed as older adult specific drinking assessment tools which evaluate alcohol-related risk based on the levels of drinking *and* factors increasing potential harm. These two tools have demonstrated face, content and criterion validity for assessing hazardous drinking among older adults (Fink, Morton, et al., 2002; Fink, Tsai, et al., 2002; Moore et al., 2002; Moore et al., 2000). The CARET has been used to assess prevalence of hazardous drinking in American older adults in various settings (Barnes et al., 2010; Sacco et al., 2015) and the healthcare expenditure differential between hazardous and non-hazardous drinking of older adults (Yan, Xu, Ettner, Barnes, & Moore, 2014). The CARET has

also been used as the basis for interventions to reduce hazardous drinking in older community-dwelling Americans (Kuerbis et al., 2015) and in primary care settings in the United States (Ettner et al., 2014; Moore et al., 2011).

The CARET offers researchers and health professionals a potentially more sensitive tool for the identification of hazardous drinking in older adults. However, it has not been employed outside of the United States in primary healthcare or for population level research. Thus, many alcohol researchers and healthcare professionals worldwide are likely to be deriving individual risk and country level hazardous drinking rates for older adults from alcohol screening tools that may underestimate risk for that population. This is particularly concerning for countries such as New Zealand which, based on AUDIT-C, shows a markedly higher rate of hazardous drinking in older adults aged 55-70 years than the United States (42% vs. 32%, respectively) (Dawson, Grant, Stinson, & Zhou, 2005; Towers et al., 2011). The New Zealand Health Survey (Ministry of Health, 2016), which uses the full AUDIT, found a steady increase in hazardous drinking as people aged. Levels of hazardous drinking peaked at the age of 55-64 (15%) and dropped to less than 5% of those aged 75+. Findings reported by other population studies from New Zealand, all using a version of AUDIT, indicate higher prevalence of hazardous drinking among adults aged 55 and above, ranging from 42% to 56% (Towers et al., 2011).

In an era when population ageing coincides with an increase in the proportion of older adults drinking hazardously, it is important to ensure that researchers and health professionals have the necessary tools to accurately assess hazardous drinking in the older adult population. The AUDIT-C is the recommended screen in primary health care in New Zealand. Although more difficult to administer and score, the CARET provides more insights into why the person is considered a hazardous drinker. It is, however, unclear to what extent

introducing a longer, older-adult specific screen would improve screening efficiency for older New Zealanders. The present study explored whether assessment of drinking risk factors specific to older adults (i.e., with the CARET) would increase the efficiency of screening for hazardous drinking compared with screening based solely on consumption levels (i.e., with the AUDIT-C). First, we compared the level of agreement between the AUDIT-C and the CARET in detecting hazardous alcohol use in older New Zealanders. Next, we investigated sources of discrepancies between the AUDIT-C and the CARET in the classification of hazardousness based on sociodemographic characteristics, comorbidities, health issues, medication use, alcohol risk behaviour, and self-reported health. Finally, we examined the health care utilization practices of hazardous drinkers. It is important to know whether older adults who drink hazardously are being seen by health professionals so that effective screening can take place.

Method

Sample

The 2016 data collection wave of the [removed for blind review] was used for this analysis. The [removed for blind review] commenced in 2006 as a biennial postal survey. A baseline sample of 13,044 New Zealanders aged 55–70 was selected from the New Zealand Electoral Roll, using equal probability random sampling (general population: $n = 4,769$; Māori population: $n = 8,275$). Māori (indigenous people of New Zealand) were oversampled to maximize participation; therefore, weighting is required to adequately reflect population level trends. The response rate was 51% resulting in a sample of $n = 6662$. Of this initial cohort, 46% ($n = 3065$) agreed to be re-approached for follow-up assessments. Using the same sampling procedure, additional cohorts were recruited in 2009 ($n = 1980$), 2010 ($n = 568$), 2014 ($n = 773$) and 2016 ($n = 1272$) to extend the capacity of the study to represent

New Zealanders aged 50 years and above. The 2016 data collection included 4028 respondents aged 50-89 years. A total of 3673 (91%) of this sample completed all relevant alcohol measures required to categorise them on both screening tools (AUDIT-C and CARET). Table 1 illustrates the characteristics of the sample weighted to be representative of the age and gender breakdown of the New Zealand older adult population as at 2016.

Measures

Additional information about the measures, response options, and number of missing cases is reported in the supplementary files.

AUDIT-C. The 3-item AUDIT-C has been used for identifying hazardous drinkers across a range of populations (Aalto, Alho, Halme, & Seppa, 2009; Babor et al., 2001; Bosque-Prous et al., 2017; Reinert & Allen, 2007). It is recommended for use in primary health care by the US National Institute on Alcohol Abuse and Alcoholism (U.S. Department of Health Human Services, 2005), and has been used in New Zealand in older adult population surveys (Towers et al., 2011) and primary health care settings (Ministry of Health, 2001). The AUDIT-C consists of three questions assessing frequency and quantity of alcohol use, and frequency of binge drinking (i.e., 6+ standard drinks per occasion) in the past 12 months. Prior research suggests that an AUDIT-C score of ≥ 4 for men and ≥ 3 for women (out of a score of 12) provides an adequate hazardous drinking threshold for older adults (Bradley et al., 2003).

CARET. The 27-item CARET evaluates whether older adults are drinking hazardously with regard to the level of alcohol use (frequency, quantity and binge) and whether such drinking occurs in the presence of critical factors known to increase the risk of alcohol-related harm for older adults, including comorbidities (e.g., diabetes), symptoms of disease (e.g., memory problems), alcohol-interactive medication use (e.g., analgesics), and alcohol risk behaviours (e.g., driving after drinking 3+ alcoholic beverages) (Barnes et al., 2010).

Sociodemographic variables. Participants completed questions pertaining to their age, gender, marital status, work status, and highest educational qualification. Socioeconomic status was assessed using the short form version of the 'Economic Living Standards Index' (ELSI) (Jensen, Spittal, Crichton, Sathiyandra, & Krishnan, 2002).

Health variables. Self-rated health was measured using the 'physical health' and 'mental health' component summary scores of the self-report 12-item Short Form Health Survey (SF-12v2) (Ware, Kosinski, Dewey, & Gandek, 2000). Physical and mental health summary scores (higher scores indicating better health) were normed for the older new Zealand population using coefficients developed from the New Zealand Health Survey (Frieling, Davis, & Chiang, 2013). Additional chronic conditions not assessed by the CARET were also included (e.g., cancer).

Healthcare utilisation. Participants completed five questions related to their healthcare utilisation in the 12 months prior to the survey. Participants indicated how many times they have 1) seen their general practitioner (GP) or family doctor; 2) used a service at, or been admitted to, a hospital; 3) been admitted to hospital for one night or longer; 4) gone to a hospital emergency department as a patient; and 5) consulted another health professional in the last 12 months.

Definition of alcohol use categories

To differentiate between lifetime and current abstainers, those indicating that they 'never' currently consume alcohol were asked to specify whether they had done so in the past. Current drinkers were categorized into non-hazardous and hazardous drinkers based on both screening tools. After examining the classification agreement between the two screens, two further drinking categories were created: 1) 'hazardous on the AUDIT-C' and 2) 'hazardous on the CARET only'.

Data Analysis

Cohen's Kappa was calculated to assess the classification agreement between AUDIT-C and CARET. Kappa values can range from -1 to +1, with +1 indicating a perfect agreement between scores. A 3-step multivariate logistic regression analysis was employed to compare drinkers classified as 'hazardous on the AUDIT-C' versus drinkers classified as 'hazardous on the CARET only' on sociodemographic characteristics (Step 1), health conditions, health issues and behaviours known to increase alcohol-related harm (Step 2), and additional health indicators not specifically linked to alcohol-related harm (Step 4). Finally, a Mann-Whitney U-test was conducted to compare the two groups in frequency of health care use. Missing data were handled with listwise deletion.

Results

Classification Agreement between AUDIT-C and CARET

Lifetime and current abstainers represented 4.3% and 12.7% of the total sample, respectively. The remaining 83% were current drinkers. Analysis indicated a moderate classification agreement between AUDIT-C and CARET $\kappa = .591$ (95% CI: .564; .618), $p < .001$, such that 79.2% of current drinkers were jointly classified as non-hazardous (40%) or hazardous drinkers (39.2%) by both screens (Table 2). AUDIT-C classified a greater proportion of drinkers as 'hazardous' (56.5%) than the CARET (42.7%). However, CARET classified 3.5% of current drinkers as 'hazardous' while the AUDIT-C classified these drinkers as non-hazardous. This is because the CARET classifies some with lower drinking levels as hazardous drinkers due to comorbidities, alcohol-interactive medication use, and alcohol risk behaviours that increase risk of harm.

Table 3 presents the classification agreement between the AUDIT-C and the CARET for men and women separately. On the AUDIT-C, 58.1% of men and 54.7% of women were

classified as hazardous drinkers. In contrast, CARET classified 53.4% of men and 31% of women as hazardous drinkers. Of the drinkers classified as 'non-hazardous' on the AUDIT-C the CARET instead classified 5.6% of men and 1.4% of the women as 'hazardous' drinkers.

Predicting 'Hazardous Drinking on the AUDIT-C' versus 'Hazardous Drinking on the CARET only'

A 3-step logistic regression was employed to investigate predictors of being classified 'hazardous on the AUDIT-C' ($n = 1722$) versus being classified 'hazardous on the CARET only' ($n = 108$). Model fit statistics and parameter estimates are reported in Table 4. Marital status (OR = 2.25), educational qualification (OR = 1.50), drink-driving (OR = 11.05), and self-reported physical health (OR = 0.95) were significant predictors of being classified 'hazardous on the CARET only'. Married/partnered participants were 2.5 times more likely to be classified as 'hazardous on the CARET only'. Every additional level of qualification increased the odds of being classified 'hazardous on the CARET only' by 1.5 times. Those who reported driving within 2 hours after drinking 3 or more alcoholic drinks were 11 times more likely to be classified 'hazardous on the CARET only'. One score increase in the self-reported physical health scale decreased the odds of being classified 'hazardous on the CARET only' by 1.05 times.

Healthcare Utilisation of 'Hazardous Drinkers on the AUDIT-C' versus 'Hazardous Drinkers on the CARET only'

Significant differences with small effect sizes were found between the two groups in GP visits and admission to hospital overnight (Table 5). Those 'hazardous on the CARET only' were more likely to have visited their GP and been admitted to hospital overnight in the previous year.

Improving Screening with the AUDIT-C by Assessing Additional Risk Factors

Driving under the influence of alcohol showed the strongest association with being classified 'hazardous on the CARET only'. The CARET considers drink-driving as an indicator of hazardousness regardless of consumption level. We examined how the classification of hazardousness and the level of agreement between the two instruments changed if the AUDIT-C scoring was supplemented by a single item assessing driving after drinking 3 or more alcoholic drinks (i.e., those reporting driving under influence of alcohol categorized as hazardous drinkers regardless of general consumption level). As a result, the classification agreement between the AUDIT-C and the CARET increased; $\kappa = .644$ (95% CI: .619; .669), $p < .001$, indicating 81.7% agreement (Table 6). The proportion of drinkers classified as hazardous on the CARET, but not on the AUDIT-C dropped to 1% (1.6% for men and 0.3% for women).

Discussion

The main objective of the study was to examine whether including assessment of risk factors specific to older adults would increase the efficiency of screening for hazardous drinking compared with screening based solely on consumption levels. We compared the agreement between AUDIT-C and CARET in classifying hazardous drinkers in a sample of older New Zealanders. Results suggest that over 80% of New Zealanders aged 50 years and older are current drinkers. The AUDIT-C classified a greater proportion as hazardous drinkers (56.5% of drinkers and 47% of the total sample) than did the CARET (42.7% of drinkers and 35% of the total sample). Given that these statistics are weighted to reflect the national population aged 50-89, it is concerning that, regardless of which screen is used, over one-third of older New Zealanders are drinking at levels that may result in harm. Furthermore, more than 50% of older New Zealand men were classified as hazardous drinkers, suggesting that they consume alcohol at a level, or in conjunction with health issues, that is potentially

harmful. This reflects previous research showing that older New Zealand men are much more likely to drink and drink hazardously than their female counterparts (Towers, Philipp, Dulin, & Allen, 2018; Towers et al., 2011), and offers cause for concern at such high rates of hazardous drinking in a population group at significant risk of alcohol-related harm.

Analyses indicated a moderate agreement between AUDIT-C and CARET. This suggests that most older adults drinking hazardously should be easily identified by health professionals through simple screening of consumption using AUDIT-C. However, the classifications by the two screens did not completely match. Specifically, 3.5% of drinkers were identified as hazardous drinkers by the CARET, but non-hazardous by the AUDIT-C. This suggests that some older adults might screen negative for hazardous use based on the quantity and frequency they drink, but are classified as hazardous drinkers on the CARET because the amount they drink is potentially harmful given their particular health conditions, symptoms, medication use, and alcohol risk behaviours. Furthermore, analysis by gender indicated that this discrepancy is mainly driven by the classification of men with health conditions, medication use, and alcohol-related risk behaviours as non-hazardous on the AUDIT-C. Only a very small proportion (1.4%) of women were classified as 'hazardous on the CARET only'. The AUDIT-C uses a lowered threshold for classifying women as hazardous drinkers. This means that women who drink small amounts of alcohol in combination with health conditions or medication use are likely to be identified with the AUDIT-C because of the stringent consumption threshold. The group who is most likely to be missed by the AUDIT-C are older men with health conditions, alcohol-interactive medication use or health risk behaviours.

Further analysis revealed that 72% of these older adults were classified as hazardous drinkers on the CARET because they reported driving within two hours after drinking 3 or

more alcoholic drinks. Driving under the influence of alcohol is a risk factor at all ages. However, driving simulation studies have demonstrated that older adults generally have poorer driving performance than younger adults, which further declines after even a moderate dose of alcohol intake (Quillian, Cox, Kovatchev, & Phillips, 1999). Moreover, research by Gilbertson, Ceballos, Prather, and Nixon (2009) suggests that, when asked to evaluate their driving performance after consuming alcohol, older adults seem to be unaware of their impairment, even though objective criteria indicate significant decline .

Additional factors that predicted classification of hazardous drinking on the CARET, but not on the AUDIT-C, were higher education, being married or partnered, and self-reported poorer physical health, although the effect sizes were much smaller than that of drink-driving. It is also important to note that the gender difference reported above disappeared once analysis accounted for comorbidities, medication use and health risk behaviours. Even though intervention could take place for those classified as 'hazardous on the CARET only', as they are visiting health services frequently (GPs in particular), by relying on consumption indicators assessed by the AUDIT-C, health professionals would classify these individuals as non-hazardous drinkers and miss the opportunity to provide intervention for potentially harmful drinking.

It is important to highlight that results were based on cross-sectional, self-report data. Analyses were performed with a large sample of older adults, representative for the gender, age and ethnic breakdown of the New Zealand population, which increases the validity of the findings. The sample, however, was not representative for other potentially important socio-demographic factors, such as education. Furthermore, items were administered in the sixth wave of a longitudinal cohort study; therefore, the sample might be affected by selective attrition and include participants who are more likely to remain in long-term cohort studies

due to better health or economic conditions. This could influence the generalizability of the findings.

Considering that there are no gold standard criteria for hazardous drinking, we cannot evaluate how accurately the screening tools defined hazardousness. It is possible that either one or both of the screens over- or underestimate hazardousness in older adults, in which case further assessment would be necessary for correct identification to take place. The AUDIT-C and the CARET define hazardous drinking using different thresholds for frequency and quantity of consumption. The AUDIT-C recommends a more stringent threshold, especially for women, whereas the CARET applies a more liberal guidelines for both men and women. Furthermore, the CARET thresholds were developed in the United States where one standard drink is defined as containing 14 grams of pure alcohol (in contrast with 10 grams in New Zealand). This might explain why the AUDIT-C identifies a greater proportion of older drinkers as hazardous even without considering health conditions, medication use and alcohol risk behaviours. A lowered threshold for consumption indicators on the CARET would likely to increase not only the identification of hazardous drinkers but also the sensitivity and specificity of the screening tool to predict alcohol-related morbidity or mortality. This was the first time the CARET was used in the New Zealand context; therefore, further analysis of its validity and cultural sensitivity is required.

In general, findings suggest that supplementing the AUDIT-C with a drink-driving criterion would sufficiently increase screening efficacy. However, considering health conditions and medication use when screening for hazardous drinking could have important benefits. The CARET is relatively long and difficult to administer; therefore, it might not be practical in a health care setting. One way to overcome this problem is to integrate the CARET with patient dashboards, such that when health care professionals administer the

AUDIT-C and register the quantity and frequency of drinking, an algorithm compares the consumption information with current health records. If alcohol-related health conditions are present or the patient is taking alcohol-interactive medication, lower consumption levels could be automatically flagged as hazardous, informing the health care professional about potential risk for harm. This would allow health care workers to keep using the AUDIT-C (a simple and easy to administer screen) but benefit from the additional information provided by a more complex, older adult-specific screen, such as the CARET.

Conclusions

In summary, findings suggest that the AUDIT-C identifies a greater proportion of older drinkers who are at potential risk of harm because of their alcohol consumption level than does the CARET. Although the AUDIT-C does not take comorbidities, health issues, and medication use into account, it applies a more stringent consumption threshold than the CARET, and therefore, older drinkers who are at risk of harm because of their co-existing medical issues are still screened positively for hazardousness with the AUDIT-C. One area where the CARET greatly outperformed the AUDIT-C in this study was identifying at risk drinkers who, although they consumed alcohol at a lower level, were likely to drive under influence of alcohol. This suggests that by supplementing the AUDIT-C with a single item asking people about drinking and driving could improve the efficiency of the screen in detecting a wider range of older adults who are at potential risk of alcohol-related harm and help health professionals to intervene early on.

References

- Aalto, M., Alho, H., Halme, J. T., & Seppa, K. (2009). AUDIT and its abbreviated versions in detecting heavy and binge drinking in a general population survey. *Drug and Alcohol Dependence, 103*(1-2), 25-29.
- Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). *AUDIT: The Alcohol Use Disorders Identification Test guidelines for use in primary care*. Retrieved from Geneva, Switzerland:
http://apps.who.int/iris/bitstream/10665/67205/1/WHO_MSD_MSB_01.6a.pdf
- Barnes, A. J., Moore, A. A., Xu, H. Y., Ang, A., Tallen, L., Mirkin, M., & Ettner, S. L. (2010). Prevalence and Correlates of At-Risk Drinking Among Older Adults: The Project SHARE Study. *Journal of General Internal Medicine, 25*(8), 840-846.
- Beullens, J., & Aertgeerts, B. (2004). Screening for alcohol abuse and dependence in older people using DSM criteria: a review. *Aging & Mental Health, 8*(1), 76-82.
- Bosque-Prous, M., Brugal, M. T., Lima, K. C., Villalbi, J. R., Bartroli, M., & Espelt, A. (2017). Hazardous drinking in people aged 50 years or older: a cross-sectional picture of Europe, 2011-2013. *International Journal of Geriatric Psychiatry, 32*(8), 817-828.
- Bradley, K. A., Bush, K. R., Epler, A. J., Dobie, D. J., Davis, T. M., Sporleder, J. L., . . . Kivlahan, D. R. (2003). Two brief alcohol-screening tests from the Alcohol Use Disorders Identification Test (AUDIT) - Validation in a female veterans affairs patient population. *Archives of Internal Medicine, 163*(7), 821-829.
- Caputo, F., Vignoli, T., Leggio, L., Addolorato, G., Zoli, G., & Bernardi, M. (2012). Alcohol use disorders in the elderly: A brief overview from epidemiology to treatment options. *Experimental Gerontology, 47*(6), 411-416.

Dawson, D. A., Grant, B. F., Stinson, F. S., & Zhou, Y. (2005). Effectiveness of the derived Alcohol Use Disorders Identification Test (AUDIT-C) in screening for alcohol use disorders and risk drinking in the US general population. *Alcoholism-Clinical and Experimental Research, 29*(5), 844-854.

Ettner, S. L., Xu, H. Y., Duru, O. K., Ang, A., Tseng, C. H., Tallen, L., . . . Moore, A. A. (2014). The Effect of an Educational Intervention on Alcohol Consumption, At-Risk Drinking, and Health Care Utilization in Older Adults: The Project SHARE Study. *Journal of Studies on Alcohol and Drugs, 75*(3), 447-457.

Fink, A., Morton, S. C., Beck, J. C., Hays, R. D., Spritzer, K., Oishi, S., & Moore, A. A. (2002). The alcohol-related problems survey: Identifying hazardous and harmful drinking in older primary care patients. *Journal of the American Geriatrics Society, 50*(10), 1717-1722.

Fink, A., Tsai, M. C., Hays, R. D., Moore, A. A., Morton, S. C., Spritzer, K., & Beck, J. C. (2002). Comparing the alcohol-related problems survey (ARPS) to traditional alcohol screening measures in elderly outpatients. *Archives of Gerontology and Geriatrics, 34*(1), 55-78.

Frieling, M. A., Davis, W. R., & Chiang, G. (2013). The SF-36v2 and SF-12v2 health surveys in New Zealand: norms, scoring coefficients and cross-country comparisons. *Australian and New Zealand journal of public health, 37*(1), 24-31.

Gilbertson, R., Ceballos, N. A., Prather, R., & Nixon, S. J. (2009). Effects of Acute Alcohol Consumption in Older and Younger Adults: Perceived Impairment Versus Psychomotor Performance. *Journal of Studies on Alcohol and Drugs, 70*(2), 242-252.

Jensen, J., Spittal, M., Crichton, S., Sathiyandra, S., & Krishnan, V. (2002). *Direct measurement of living standards: The New Zealand ELSI scale*. Retrieved from Wellington, New Zealand:

Johnson, I. (2000). Alcohol problems in old age: A review of recent epidemiological research.

International Journal of Geriatric Psychiatry, 15(7), 575-581.

Knott, C. S., Coombs, N., Stamatakis, E., & Biddulph, J. P. (2015). All cause mortality and the case for age specific alcohol consumption guidelines: pooled analyses of up to 10 population based cohorts. *Bmj-British Medical Journal*, 350.

Kuerbis, A. N., Yuan, S. E., Borok, J., LeFevre, P. M., Kim, G. S., Lum, D., . . . Moore, A. A.

(2015). Testing the Initial Efficacy of a Mailed Screening and Brief Feedback Intervention to Reduce At-Risk Drinking in Middle-Aged and Older Adults: The Comorbidity Alcohol Risk Evaluation Study. *Journal of the American Geriatrics Society*, 63(2), 321-326.

Ministry of Health. (2001). *DHB Toolkit: Minimising Alcohol and Other Drug Related Harm*

Retrieved from

[http://www.moh.govt.nz/notebook/nbbooks.nsf/0/03F11262E2F655C2CC25778A006DED5/\\$file/alcohol-drugs-toolkit-08.pdf](http://www.moh.govt.nz/notebook/nbbooks.nsf/0/03F11262E2F655C2CC25778A006DED5/$file/alcohol-drugs-toolkit-08.pdf)

Ministry of Health. (2016). *Annual Update of Key Results 2015/16: New Zealand Health Survey*. Retrieved from Wellington, New Zealand:

Moore, A. A., Beck, J. C., Babor, T. F., Hays, R. D., & Reuben, D. B. (2002). Beyond alcoholism: Identifying older, at-risk drinkers in primary care. *Journal of Studies on Alcohol*, 63(3), 316-324.

Moore, A. A., Blow, F. C., Hoffing, M., Welgreen, S., Davis, J. W., Lin, J. C., . . . Barry, K. L.

(2011). Primary care-based intervention to reduce at-risk drinking in older adults: a randomized controlled trial. *Addiction*, 106(1), 111-120.

Moore, A. A., Giuli, L., Gould, R., Hu, P. F., Zhou, K. F., Reuben, D., . . . Karlamangla, A. (2006).

Alcohol use, comorbidity, and mortality. *Journal of the American Geriatrics Society*, 54(5), 757-762.

Moore, A. A., Hays, R. D., Reuben, D. B., & Beck, J. C. (2000). Using a criterion standard to

validate the Alcohol-Related Problems Survey (ARPS): A screening measure to identify harmful and hazardous drinking in older persons. *Aging-Clinical and Experimental Research*, 12(3), 221-227.

O'Connell, H., Chin, A. V., Cunningham, C., & Lawlor, B. (2003). Alcohol use disorders in

elderly people - redefining an age old problem in old age. *British Medical Journal*, 327(7416), 664-667.

Quillian, W. C., Cox, D. J., Kovatchev, B. P., & Phillips, C. (1999). The effects of age and alcohol

intoxication on simulated driving performance, awareness and self-restraint. *Age and Ageing*, 28(1), 59-66.

Reinert, D. F., & Allen, J. P. (2007). The Alcohol Use Disorders Identification Test: An update of

research findings. *Alcoholism-Clinical and Experimental Research*, 31(2), 185-199.

Rice, N. E., Lang, I. A., Henley, W., & Melzer, D. (2011). Common health predictors of early

retirement: findings from the English Longitudinal Study of Ageing. *Age and Ageing*, 40(1), 54-61.

Sacco, P., Burruss, K., Smith, C. A., Kuerbis, A., Harrington, D., Moore, A. A., & Resnick, B.

(2015). Drinking behavior among older adults at a continuing care retirement community: affective and motivational influences. *Aging & Mental Health*, 19(3), 279-289.

Savage, C. (2014). The baby boomers and substance use: are we prepared? *Journal of*

Addictions Nursing, 25(1), 1-3.

- Solberg, L. I., Maciosek, M. V., & Edwards, N. M. (2008). Primary care intervention to reduce alcohol misuse: ranking its health impact and cost effectiveness. *American journal of preventive medicine, 34*(2), 143-152. e143.
- Topiwala, A., Allan, C. L., Valkanova, V., Zsoldos, E., Filippini, N., Sexton, C., . . . Ebmeier, K. P. (2017). Moderate alcohol consumption as risk factor for adverse brain outcomes and cognitive decline: longitudinal cohort study. *Bmj-British Medical Journal, 357*.
- Towers, A., Philipp, M., Dulin, P., & Allen, J. (2018). The "Health Benefits" of Moderate Drinking in Older Adults may be Better Explained by Socioeconomic Status. *Journals of Gerontology Series B-Psychological Sciences and Social Sciences, 73*(4), 649-654.
- Towers, A., Stephens, C., Dulin, P., Kostick, M., Noone, J., & Alpass, F. (2011). Estimating older hazardous and binge drinking prevalence using AUDIT-C and AUDIT-3 thresholds specific to older adults. *Drug and Alcohol Dependence, 117*(2-3), 211-218.
- U.S. Department of Health Human Services. (2005). *Helping patients who drink too much: A clinician's guide*. Retrieved from Washington:
- Ware, J. E., Kosinski, M., Dewey, J. E., & Gandek, B. (2000). *SF-36 health survey: manual and interpretation guide*: Quality Metric Inc.
- World Health Organization. (1994). *Lexicon of alcohol and drug terms* Geneva: World Health Organization.
- World Health Organization. (2015). WHO Fact Sheet: Alcohol. Retrieved from <http://www.who.int/mediacentre/factsheets/fs349/en/>
- Yan, T. J., Xu, H. Y., Ettner, S. L., Barnes, A. J., & Moore, A. A. (2014). At-Risk Drinking and Outpatient Healthcare Expenditures in Older Adults. *Journal of the American Geriatrics Society, 62*(2), 325-328.

Table 1. Characteristics of the 2016 sample using stratification weighting

	Total*		Men		Women	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Demographics						
<i>N</i>	3,673	100	1,877	51	1,795	49
Mean age (SD)	65.5 (7)	-	65.5 (6)	-	65.5 (7)	-
Missing	0	-	0	-	0	-
Employment status						
Working	1,917	63	1,057	66	860	59.9
Retired	786	26	389	24.3	397	27.7
Other	333	11	155	9.7	178	12.4
Missing	637	-	277	-	360	-
Marital Status						
Married/partnered	2781	76.3	1557	83.7	1,223	68.8
Divorced/separated	373	10.3	138	7.4	235	13.2
Widow/widower	271	7.5	54	2.9	217	12.2
Single/never married	215	5.9	112	6	103	5.8
Missing	33	-	16	-	17	-
Educational qualifications						
No qualification	716	19.5	388	20.9	328	18.5
High School	880	24	392	21.2	488	27.5
Post-High School/Trade	1228	33.4	677	36.5	550	31
Tertiary	806	22	397	21.4	409	23.1
Missing	42	-	22	-	20	-

Note. Category totals indicated may not sum to total sample *N* due to missing data on individual survey variables. *; One person identified as gender diverse.

Table 2. Comparison of the level of agreement between the AUDIT-C and the CARET classifications of hazardous and non-hazardous drinkers.

		AUDIT-C		
		Non-hazardous drinker	Hazardous drinker	Total
		n	n	N
CARET	Non-hazardous drinker			
		n 1220	527	1747
		% 40.0%	17.3%	57.3%
	Hazardous drinker			
		n 108	1195	1303
		% 3.5%	39.2%	42.7%
	Total			
		N 1328	1722	3050
		% 43.5%	56.5%	100.0%

Table 3. Comparison of the level of agreement between the AUDIT-C and the CARET classifications of hazardous and non-hazardous drinkers by gender.

		AUDIT-C		
		Non-hazardous drinker	Hazardous drinker	Total
		n	n	N
Men				
CARET	Non-hazardous drinker			
		n 582	164	746
		% 36.4%	10.2%	46.6%
	Hazardous drinker			
		n 89	766	855
		% 5.6%	47.8%	53.4%
	Total			
		n 671	930	1601
		% 41.9%	58.1%	100.0%
Women				
CARET	Non-hazardous drinker			
		n 637	363	1000
		% 44.0%	25.1%	69.0%
	Hazardous drinker			
		n 20	429	449
		% 1.4%	29.6%	31.0%
	Total			
		n 657	792	1449
		% 45.3%	54.7%	100.0%

RUNNING HEAD: Comparison of the AUDIT-C and the CARET with older New Zealanders

Table 4. *Logistic regression of the prediction of being classified being classified hazardous on the AUDIT-C (ref) classified hazardous on the CARET only*

	Step 1			Step 2			OR
	OR	95% C.I.		OR	95% C.I.		
		Lower	Upper		Lower	Upper	
Economic Living Standards	0.968	0.930	1.007	0.975	0.931	1.021	1.00
Sex (Male)	3.342***	1.954	5.718	1.578	0.860	2.895	1.42
Work Status (Working)	0.470*	0.225	0.982	0.312**	0.138	0.702	0.44
Retirement Status (Retired)	0.451	0.193	1.054	0.325*	0.128	0.828	0.42
Marital Status (In Relationship)	1.676	0.934	3.007	2.067*	1.114	3.833	2.24
Level of Education	1.316*	1.042	1.661	1.405**	1.083	1.822	1.49
Age	0.996	0.952	1.042	0.983	0.933	1.035	0.97
Drink-driving (Yes)				10.375***	6.054	17.778	11.0
Chronic Conditions (CARET)				1.133	0.834	1.539	1.08
Disease Symptoms				1.020	0.884	1.178	0.93
Alcohol Interactive Medications				0.819	0.480	1.395	0.61
SF-12 Physical Health							0.95

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SF-12 Mental Health 0.98
 Additional Chronic Conditions 1.11

Model Fit Statistics

-2 Log likelihood	633.342	542.623	528.
Cox & Snell R ²	0.027	0.087	0.09
Nagelkerke R ²	0.074	0.232	0.25
Hosmer & Lemeshow Test	$\chi^2(8) = 10.183, p = .252$	$\chi^2(8) = 4.400, p = .819$	$\chi^2(8)$
Model	$\chi^2(7) = 40.193, p < .001$	$\chi^2(11) = 130.913, p < .001$	$\chi^2(14)$

Note. *, $p < .05$; **, $p < .01$; *** $p < .001$; OR = odds ratio

Table 5. Comparing hazardous drinking groups on health care utilization.

	Hazardous AUDIT		Hazardous CARET only		Mann-Whitney U-test
	N	%	N	%	
GP Visit					
Never	134	7.9	9	8.4	$U = 70912.5, Z = -1.98, p = .047, r = .049$
1 time	300	17.7	11	10.2	
2 times	417	24.7	24	22.5	
3-5 times	657	38.9	49	45.2	
6-11 times	153	9.0	10	9.4	
12 times or more	30	1.8	5	4.3	
Median	2 times		3-5 times		
Mean rank	828.78		922.28		
Used a service at/been admitted to, a hospital					
Never	1100	64.5	68	62.2	$U = 79847, Z = -0.170, p = .865, r = .004$
1 time	492	28.8	36	33.3	
2 times	90	5.3	4	3.3	
3-5 times	23	1.4	1	1.2	
6-11 times	0	0.0	0	0.0	
12 times or more	0	0.0	0	0.0	
Median	Never		Never		
Mean rank	840.57		847.69		
Been admitted to hospital for one night or longer					
Never	1503	88.3	84	80.2	$U = 72170.5, Z = -2.240, p = .025, r = .055$
1 time	181	10.6	19	18.5	
2 times	16	0.9	1	1.3	
3-5 times	3	0.2	0	0.0	
6-11 times	0	0.0	0	0.0	
12 times or more	0	0.0	0	0.0	
Median	Never		Never		
Mean rank	834.76		898.01		
Gone to a hospital emergency department as a patient					
Never	1459	85.7	85	80.2	$U = 73375, Z = -1.619, p = .105, r = .040$
1 time	226	13.3	19	18.0	
2 times	14	0.8	2	1.8	
3-5 times	2	0.1	0	0.0	

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6-11 times	0	0.0	0	0.0
12 times or more	0	0.0	0	0.0
Median	Never		Never	
Mean rank	835.06		884.84	

Consulted a specialist/other health professional

Never	854	50.4	51	47.7	<i>U = 70918.5, Z = -1.772, p = .076, r = .043</i>
1 time	605	35.7	33	31.1	
2 times	174	10.3	14	13.5	
3-5 times	62	3.7	8	7.6	
6-11 times	0	0.0	0	0.0	
12 times or more	0	0.0	0	0.0	
Median	Never		1 time		
Mean rank	830.20		910.32		

Table 6. Comparison of the level of agreement between the AUDIT-C supplemented by a drinking and driving question and the CARET classifications of hazardous and non-hazardous drinkers.

		AUDIT-C + Drink-driving		
		Non-hazardous drinker	Hazardous drinker	Total
		n	n	N
CARET	Non-hazardous drinker			
		n 1220	527	1747
		% 40.0%	17.3%	57.3%
	Hazardous drinker			
		n 30	1273	1303
		% 1.0%	41.7%	42.7%
	Total			
		N 1250	1800	3050
		% 41.0%	59.0%	100.0%

Supplementary materials

Response options, descriptive statistics and number of missing cases for each variable included in the analyses.

Consumption indicators for both the AUDIT-C and the CARET

	<i>N</i>	%
Frequency		
Never	622	16.9
Monthly or less	711	19.4
2-4 times a month	611	16.6
2-3 times a week	721	19.6
4+ times a week	1008	27.4
Missing	0	-
Quantity		
1-2	2564	71.5
3-4	679	18.9
5-6	220	6.1
7-9	81	2.2
10+	43	1.2
Missing	86	-
Bingeing (drinking 6 or more drinks per occasion)		
Never	2766	75.6
Less than monthly	442	12.1
Monthly (once or 2-3 times)	215	5.9
Weekly (Once or 2-3 times)	185	5.0
Daily or almost daily (including 4-5 times a week)	53	1.4
Missing	12	-

RUNNING HEAD: Comparison of the AUDIT-C and the CARET with older New Zealanders

Alcohol-related risk factors assessed by the CARET

Chronic conditions (diagnosed by a health professional)

Response option	Diabetes		High blood pressure		Depression		Active or chronic gout		Active/chronic hepatitis, cirrhosis or other liver condition	
	N	%	N	%	N	%	N	%	N	%
No	3178	89.4	2209	61.9	3117	87.3	3308	93.0	3483	97.8
Yes	378	10.6	1361	38.1	454	12.7	250	7.0	79	2.2
Missing	117	-	103	-	102	-	115	-	111	-

Symptoms of disease (last 12 months)

Response option	Problems sleeping		Feeling sad or blue		Memory problems		Heartburn, stomach pain, nausea, or vomiting		Tripping, bumping into things		N
	N	%	N	%	N	%	N	%	N	%	
Never or rarely	1215	33.4	2197	60.9	1868	51.6	2343	65.0	2734	75.5	2734
Sometimes	1709	47.0	1287	35.6	1569	43.4	1124	31.2	804	22.2	799
Often	714	19.6	127	3.5	179	4.9	137	3.8	84	2.3	434
Missing	35	-	62	-	56	-	68	-	50	-	23

RUNNING HEAD: Comparison of the AUDIT-C and the CARET with older New Zealanders

Medication use (at least 3-4 times per week)

Type of medication		No	Yes	Missing
Two or more regular or extra strength (100mg or more) aspirins	N	3064	490	119
	%	86.2	13.8	-
Arthritis and pain medicines	N	2650	912	111
	%	74.4	25.6	-
Ulcer and stomach medication	N	2947	592	134
	%	83.3	16.7	-
Blood pressure medicines	N	2294	1293	85
	%	64.0	36.0	-
Nitrate medicines	N	3431	92	150
	%	97.4	2.6	-
Anti-depressant medicines	N	3187	363	122
	%	89.8	10.2	-
Anticoagulants or blood thinners	N	3170	376	126
	%	89.4	10.6	-
Seizure medicines	N	3478	38	157
	%	98.9	1.1	-
Non-prescription medicines for allergies or sleep problems	N	3343	186	143
	%	94.7	5.3	-
Prescription sedatives or sleeping medicines	N	3340	186	146
	%	94.7	5.3	-
Stronger narcotic medications	N	3325	198	149
	%	94.4	5.6	-

Drinking and driving (within 2 hours of drinking 3 or more standard drinks)

Response option	<i>N</i>	%
Never	3173	86.9
1-2 days	280	7.7
3-9 days	119	3.3
10-15 days	32	0.9
16-20 days	10	0.3
21 or more days	37	1.0
Missing	21	-

Additional health and sociodemographic variables assessed in the [removed for blind review] Study

	<i>M</i>	<i>SD</i>	<i>Range</i>	<i>N of Missing</i>
Economic Living Standards Index	24.67	6.01	0-31	95
SF-12 Physical Component Score	47.17	10.04	0-100	106
SF-12 Mental Component Score	50.19	9.69	0-100	106
Number of additional chronic conditions	1.49	1.38	0-9	41

RUNNING HEAD: Comparison of the AUDIT-C and the CARET with older New Zealanders

Health care utilization practices assessed in the [removed for blind review] Study

Response option	GP visits		Hospital admission		Hospital admission overnight		Emergency department		Specialist visits	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Never	256	7.1	2293	63.0	3088	85.1	3007	82.9	1856	51.2
1 time	603	16.7	1072	29.5	486	13.4	570	15.7	1239	34.2
2 times	832	23.0	189	5.2	41	1.1	41	1.1	346	9.5
3-5 times	1442	39.9	83	2.3	15	0.4	12	0.3	184	5.1
6-11 times	383	10.6	-	-	-	-	-	-	-	-
12 times or more	95	2.6	-	-	-	-	-	-	-	-
Missing	62	-	35	-	44	-	43	-	47	-

