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Published in:
European Addiction Research

DOI:
[10.1159/000530823](https://doi.org/10.1159/000530823)

Publication date:
2023

Document Version
Publisher's PDF, also known as Version of record

[Link to publication in Tilburg University Research Portal](#)

Citation for published version (APA):
Esselink, A., Bovens, R. H. L. M., van de Mheen, D. H. M., Gesthuizen, M. J. W., & Mathijssen, J. J. P. (2023). Towards a new definition of the typical day in the alcohol use disorder identification test-consumption. *European Addiction Research*, 29(4), 264-271. <https://doi.org/10.1159/000530823>

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Towards a New Definition of the Typical Day in the Alcohol Use Disorder Identification Test-Consumption

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Keywords

AUDIT-C · Alcohol consumption · Validation

Abstract

Introduction: The standard screening instrument for alcohol problems in the current primary care, the Alcohol Use Disorder Identification Test-Consumption (AUDIT-C), contains a question about alcohol consumption “on a typical day.” Since this is a term that leaves room for multiple interpretations and the differences between alcohol consumption on weekends and weekdays are not taken into account, this study examines whether the latter distinction improves the prediction validity of the screening instrument. **Methods:** A subgroup of 852 participants of the Dutch version of Dry January (“NoThanks”) 2022 got the annual “NoThanks” survey, including questions about their alcohol consumption on weekends and weekdays, and the original ten AUDIT questions. The full AUDIT was used as golden standard. Sensitivity, specificity, and receiver operating characteristic curves were calculated for the original and different versions of the AUDIT-C. **Results:** Of all participants, 67 percent were hazardous drinkers (AUDIT ≥ 8) and 27 percent were harmful drinkers (AUDIT ≥ 16). For the original AUDIT-C, the cut-off score with the most balanced combination of sensitivity and specificity for hazardous drinking in men was 7 and in women was 6. For harmful drinking,

this was 8 and 7, respectively. Certain versions performed equally well as the original. For harmful drinkers, the highest area under the receiver operating characteristic curve (AUROC) was 0.814 and 0.866 for the original AUDIT-C, for men and women, respectively. Only for hazardous drinking men, the AUDIT-C with weekend day (AUROC = 0.887) performed slightly better than the original. **Conclusion:** Distinguishing weekend- and weekday alcohol consumption in the AUDIT-C does not lead to better predictions of problematic alcohol use. However, the distinction between weekends and weekdays provides more detailed information for health-care professionals and can be used without having to compromise too much on validity.

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Published by S. Karger AG, Basel

Introduction

Alcohol use contributes substantially to the worldwide burden of disease [1, 2], and excessive alcohol use increases the risk of chronic diseases such as liver disease and cancer, fatalities, and injuries [3, 4]. Early problematic alcohol use identification increases recovery chances and prevents serious health damage [5, 6]. Screening, brief intervention and referral to treatment (SBIRT) is a

worldwide promoted approach in primary healthcare and hospital settings to intervene in an early stage to prevent problematic alcohol use. The Alcohol Use Disorder Identification Test (AUDIT) is the most widely used and tested instrument for screening alcohol problems in primary care since 1989 [7]. This instrument was designed by the World Health Organization (WHO) to help with the early identification of people with (potentially) high-risk alcohol consumption. The questionnaire contains ten questions about alcohol consumption (1–3), alcohol dependence (4–6), and harmful alcohol use (7–10) and is considered the golden standard for screening for problematic use [8, 9].

The AUDIT-C is the abbreviated version and consists of the first three questions of the AUDIT that measure the frequency and amount of alcohol consumption. These three questions constitute a practical and valid screening for heavy drinkers who have not yet experienced adverse effects from their alcohol consumption [9, 10]. The advantage of using the AUDIT-C in primary care or emergency rooms in hospitals is that the questionnaire is shorter and less intensive, reducing the risk of response and reporting bias. Healthcare professionals therefore use the AUDIT-C as a first indication of problematic use [11]. The AUDIT-C score determines whether the full AUDIT should be administered.

Need for Validation of AUDIT-C

An optimal screening instrument for problem drinking is short and acceptable to healthcare professionals and patients [9]. In addition, it needs to be sensitive and specific enough to identify heavy drinkers, harmful drinkers, and those without problematic alcohol use. When a questionnaire does not fully measure what it is supposed to measure, its predictive power is low and problematic alcohol use cannot be detected sufficiently [12]. When the AUDIT was developed, the ten questions showed high face validity and high correlation with alcohol consumption [13]. Since then, many validity studies of the AUDIT(-C) have been carried out in many different settings and populations. The studies mainly focus on determining the cut-off values for problematic alcohol use for different populations and countries [12, 14]. While the sensitivity (i.e., the percentage of well-identified individuals) of the AUDIT-C varies between 80 and 90 percent [9], the content validity of the questionnaire can be questioned.

Although the AUDIT(-C) originally contained two questions about alcohol consumption, namely, consumption in the past and in a typical month, it was ultimately decided to include only one question asking about alcohol

consumption on a typical day. The motivation was that this more direct measurement of alcohol consumption solved the presumed problem of the two original questions being too complicated for a screening instrument [15]. The combination of alcohol consumption on a typical day and a question about how many days a month a person drinks alcohol was considered to be the most inclusive way to measure alcohol consumption. The choice for the second question of the AUDIT(-C) about alcohol consumption on a typical day and its validity remain unclear [15]. In asking about alcohol consumption on a typical day, however, the term “typical” might be considered problematic. People may have different interpretations of a “typical day,” and it is not clear on which information they base their answer: for example, an average, the highest frequency, or the lowest frequency. In other words, the term “typical day” is insufficiently specific and leaves room for interpretation, which can lead to unreliable and non-valid answers [16, 17]. This may be detrimental to the content validity of the question and ultimately the predictive power of the screening test. The annual “NoThanks” survey, a questionnaire distributed among participants of the Dutch equivalent of Dry January in England, provides a unique opportunity to study the extent to which this predictive power is indeed hampered.

The aim of “NoThanks” (IkPas) is to make people aware of their alcohol use, the consequences of their consumption, and to encourage them to break their habits [18, 19]. In the survey, participants are asked about their participation, experiences, and the frequency and volume of alcohol consumption. Crucially, it distinguishes alcohol consumption on weekends and weekdays. Every year, analyses of these data show that there is a difference in alcohol consumption on weekends and weekdays both in frequency and in volume [19]. The wording of the question in the AUDIT-C about how many glasses of alcoholic beverage people drink on a “typical day” does not account for this difference between weekends and weekdays.

It may be assumed that by breaking down the “typical day” question in the AUDIT(-C) into weekend- and weekdays, the question becomes more concrete and that this approaches true patterns more closely than information based on the typical day question. Furthermore, this distinction will give healthcare professionals a clearer picture of drinking patterns. Drinking alcohol during the week can have a different motive than drinking on the weekend [20, 21]. On weekdays, people drink more to cope or to reduce stress and tension, while on weekend days, drinking seems to be more socially motivated [22].

Older people have higher alcohol consumption on weekdays, while men and students engage in more frequent binge drinking [22, 23]. These varying drinking patterns may cause different interpretations of a typical day and possibly differentially affect someone's daily life and drinking problems and may ultimately require other interventions [21, 24]. The aim of this study was to answer the following research question: to what extent does the distinction between weekend- and weekday alcohol use contribute to improving the validity of the AUDIT-C screening instrument?

Materials and Methods

Research Design

This study used quantitative data from "NoThanks" 2022. Participants of "NoThanks" sign up for the abstinence period and receive an online questionnaire (as baseline measurement). They are asked about their current drinking behaviour, drinking motives, and various background characteristics (e.g., gender, age, education). The questionnaire contained the original ten questions of the AUDIT, including the typical day question and in addition the questions about alcohol consumption on weekends and weekdays.

The full AUDIT served as the golden standard, which determined whether a person shows problematic alcohol use. The performance of the AUDIT-C as screening instrument is defined by the full AUDIT. The performance of the original AUDIT-C, including the second question: "*How many standard drinks containing alcohol do you have on a typical day when drinking?*", was compared to different versions of the AUDIT-C. These versions are explained further below and consist of two questions: "*How many standard drinks containing alcohol do you have on a typical weekday when drinking?*" and "*How many standard drinks containing alcohol do you have on a typical weekend day when drinking?*"

Participants

The study population consisted of participants of "NoThanks" 2022. For this study, a subgroup consisting of 2,525 participants (50% women and 50% men), who did not participate in "NoThanks" 2021, was approached with a separate questionnaire, including the full AUDIT and questions on alcohol consumption on weekdays and weekend days. This subgroup was approached in the period from December 30, 2021, to January 5, 2022, of which 1,021 responded in the end. The total response rate comes to 40.4%. All respondents who did not fully complete the AUDIT and alcohol consumption questions (16.7%) were not included in this study. This resulted in a sample of 852 respondents, with a mean age of 48.9 years and 57.7% of whom were women.

Measures

In the questionnaire, the ten AUDIT questions were included (Cronbach's $\alpha = 0.83$). Each of the ten questions of the AUDIT consists of categories from 0 to 4. To calculate the score on the complete AUDIT, a scale from 0 to 40 points was created, based on the sum of the ten questions. The higher the score, the more

problematic someone's alcohol use is. When someone had a score of 8 points or higher on the full AUDIT, that person was identified as a hazardous drinker [13, 25]. Someone with a score of 16 or higher was identified as a harmful drinker in accordance with WHO standards [26]. For the analyses, two dichotomized scores were created: one for hazardous alcohol consumption (AUDIT scores ≥ 8) and one for harmful alcohol consumption (AUDIT scores ≥ 16).

The AUDIT-C was formed based on the first three questions of the AUDIT and consists of a scale from 0 to 12 (Cronbach's $\alpha = 0.69$). Since cut-off scores in the AUDIT-C for women are lower than for men [14], optimal cut-off points will be determined separately.

Next to the AUDIT questions, alcohol use was measured by asking the frequency of drinking days on Mondays to Thursdays (weekdays) and the frequency of drinking days on the weekend in the past year. The frequency ranges from 0 to less than 1 day, 1 day, 2 days, 3 days (weekend), and up to 4 days (weekday). In addition, respondents were asked how many units they typically drink on a weekday and a weekend day, respectively. The answer categories were merged to form the same four categories as the AUDIT-C, consisting of categories 0–2 units (0), 3–4 units (1), 5–6 units (2), 7–9 units (3), and 10+ units (4).

Various alternatives for the second question of the AUDIT-C were evaluated, specifically: a typical weekday unit, a typical weekend day unit, the average unit (the mean of the typical weekday unit and the typical weekend day unit), the lowest and highest number of units someone mentioned in a week, and the least and most mentioned score in a week (which is calculated based on the frequency of drinking days). Scores with 0.5 are rounded up to the higher category, as people often underestimate their drinking behaviour [7]. With these seven alternatives, seven different versions of the AUDIT-C were formed, with the second question replaced by these alternatives.

Statistical Analysis

The data were analysed using IBM SPSS Statistics 27. To answer the research question, bivariate correlations, reliability analysis, and receiver operating characteristic curve analysis were used. For different cut-off points in the AUDIT-C (4–8), sensitivity and specificity were calculated. Sensitivity is the proportion of participants that are identified by the full AUDIT as hazardous/harmful drinkers, who are also identified by the AUDIT-C. Specificity is the proportion of participants that are identified as non-problem drinkers who are also identified as such by the AUDIT-C. Receiver operating characteristic curve analysis was used to determine areas under the curve, which corresponds to the probability that a hazardous/harmful drinker has a higher AUDIT-C score than a non-problem drinker. These areas under the receiver operating characteristic curves (AUROCs) measure the screening performance of a screening instrument [27]. Sensitivity is plotted against the false-positive rate (1 – specificity). AUROC values higher than 0.80 are perceived as excellent [28].

Firstly, with these results, optimal cut-off points were determined in the original AUDIT-C for identifying hazardous and harmful drinkers for men and women separately. Secondly, the sensitivity, specificity, and AUROC values found for the determined cut-off points were compared with the values of the seven alternative versions of the AUDIT-C to test whether these versions performed better than the original AUDIT-C.

Table 1. Pearson correlations of different measures of typical day consumption and AUDIT(-C) (N = 852)

| | AUDIT-C score | AUDIT score | Typical day | Typical weekday | Typical weekend day | Mean weekday/ weekend day | Highest number | Lowest number | Most mentioned |
|---------------------------|---------------|-------------|-------------|-----------------|---------------------|---------------------------|----------------|---------------|----------------|
| Typical day | 84*** | 74*** | – | – | – | – | – | – | – |
| Weekday | 72*** | 67*** | 70*** | – | – | – | – | – | – |
| Weekend day | 81*** | 74*** | 83*** | 67*** | – | – | – | – | – |
| Mean weekday/ weekend day | 83*** | 75*** | 83*** | 83*** | 93*** | – | – | – | – |
| Highest number | 82*** | 74*** | 84*** | 69*** | 99*** | 94*** | – | – | – |
| Lowest number | 72*** | 67*** | 70*** | 98*** | 69*** | 83*** | 68*** | – | – |
| Most mentioned | 75*** | 68*** | 83*** | 67*** | 92*** | 87*** | 93*** | 66*** | – |
| Least mentioned | 72*** | 68*** | 66*** | 91*** | 71*** | 83*** | 71*** | 92*** | 54*** |

****p* < 0.001.

Table 2. Reliability AUDIT(-C) with different measures of question 2

| Different measures question 2 | AUDIT-C | AUDIT |
|-------------------------------|---------|-------|
| Typical day | 692 | 825 |
| Weekday | 694 | 822 |
| Weekend day | 721 | 827 |
| Mean weekday/weekend day | 729 | 827 |
| Highest number | 726 | 828 |
| Lowest number | 692 | 822 |
| Most mentioned | 684 | 821 |
| Least mentioned | 713 | 824 |

Results

Older people appear to be overrepresented; 66% are older than 45 years and 56% are between 45 and 65 years. The research population is also relatively highly educated, with 65% having completed higher education. Participants drink more on a typical weekend day than on a typical weekday. Based on the full AUDIT, 67% of the participants are classified as hazardous drinkers (scores ≥ 8) and 27% are classified as harmful drinkers (scores ≥ 16). Men have an average score of 12.7 on the full AUDIT and an average of 7.3 on the AUDIT-C; for women, this is 10.8 and 6, respectively.

Pearson correlations are presented in Table 1 for the original second question of the AUDIT-C, the seven alternatives, and the AUDIT score. All the correlations are significant (*p* < 0.001). The highest correlation is between the lowest frequency and a typical weekday

(0.99). On weekdays, participants drink alcohol relatively less frequently (0.98), and on the weekends, they drink most frequently (0.99). There also appears to be a high correlation between a typical weekend day and a typical day (0.82) and a relatively weaker correlation between a typical weekday and a typical day (0.67).

Looking at the correlation scores between the seven alternatives of the typical day question and the AUDIT, the differences are slight. For both the AUDIT and the AUDIT-C, the typical day question, typical weekend day, the mean of a weekend and weekday, and the highest number of units in a week show the highest correlations, varying between 0.75 and 0.74 for the AUDIT and between 0.84 and 0.81 for the AUDIT-C. Reliability analysis with the eight different questions within the AUDIT(-C) shows high Cronbach's alpha (Table 2). There are only slight differences for the full AUDIT, ranging between 0.821 and 0.828. The same applies to the AUDIT-C, with values varying between 0.684 and 0.729.

As a first step, optimal cut-off points were determined, for men and women, in the original AUDIT-C. These results are shown in Table 3. For hazardous drinking, sensitivity was high (>80) for all cut-off points for men, while for women, this declined after cut-off point 6. Specificity increased from cut-off points 4 to 7 but declined rapidly for cut-off point 8. The highest AUROC values for cut-off points 7 (men) and 6 (women) were 0.88 and 0.87. Overall, for hazardous drinking, the cut-off points of 7 for men and 6 for women showed the most balanced combination of sensitivity and specificity.

For harmful drinking, the cut-off point that showed the most balanced combination of sensitivity and

Table 3. Sensitivity, specificity, AUROC, and confidence interval for different cut-off AUDIT-C in identifying hazardous (AUDIT ≥ 8) and harmful (AUDIT ≥ 16) drinkers

| AUDIT-C | | ≥ 4 | ≥ 5 | ≥ 6 | ≥ 7 | ≥ 8 |
|--|---------------------|-------------|-------------|-------------|-------------|-------------|
| <i>Hazardous AUDIT ≥ 8</i> | | | | | | |
| Men | Sensitivity | 99.6 | 98.9 | 93.9 | 84.9 | 91.7 |
| | Specificity | 14.6 | 42.7 | 75.6 | 87.8 | 22 |
| | AUROC | 0.571* | 0.708*** | 0.847*** | 0.878*** | 0.802*** |
| | Confidence interval | 0.496–0.646 | 0.634–0.782 | 0.790–0.905 | 0.839–0.918 | 0.759–0.846 |
| Women | Sensitivity | 99.7 | 96 | 84.5 | 63.6 | 66 |
| | Specificity | 33.3 | 68.2 | 89.2 | 98.5 | 68.7 |
| | AUROC | 0.665*** | 0.821*** | 0.869*** | 0.810*** | 0.709*** |
| | Confidence interval | 0.613–0.717 | 0.778–0.863 | 0.834–0.903 | 0.773–0.848 | 0.664–0.753 |
| <i>Harmful AUDIT ≥ 16</i> | | | | | | |
| Men | Sensitivity | – | – | 6.3 | 42.3 | 85.6 |
| | Specificity | – | – | 98.4 | 82.7 | 73.9 |
| | AUROC | – | – | 0.659*** | 0.765*** | 0.814*** |
| | Confidence interval | – | – | 0.603–0.714 | 0.718–0.812 | 0.767–0.861 |
| Women | Sensitivity | – | – | – | 94.9 | 79.5 |
| | Specificity | – | – | – | 78.4 | 91.7 |
| | AUROC | – | – | – | 0.866*** | 0.856*** |
| | Confidence interval | – | – | – | 0.832–0.901 | 0.810–0.902 |

* $p < 0.05$, *** $p < 0.001$.

specificity was 8 for men. Sensitivity was twice as high as for cut-off point 7, and this AUROC was highest (0.81, 95% CI: 0.77–0.86). For women, the best cut-off point was 7. While this combination is less balanced in sensitivity and specificity, sensitivity was very high (94.9). The AUROC (0.87, 95% CI: 0.83–0.90) was higher for this cut-off point as well. In conclusion, the most optimal cut-off points for harmful drinking were 8 for men and 7 for women.

For these chosen cut-off points, sensitivity, specificity, and AUROC values of the different versions were compared to determine whether an alternative performs better. These results can be found in Table 4. For hazardous drinking in men, the AUDIT-C with weekend days had the most balanced combination of sensitivity and specificity, plus the highest AUROC (0.89, 95% CI: 0.85–0.93). This version increased the AUROC by approximately 1 percentage point compared to the original AUDIT-C. For hazardous drinking in women, the original AUDIT-C performed better than all the other versions, with a sensitivity and specificity of 84.5 and 89.2, plus the highest AUROC (0.87, 95% CI: 0.83–0.90).

For harmful drinking in men, the original AUDIT-C also had the best balanced combination of sensitivity and specificity and performed better than the alternative versions (AUROC 0.81, 95% CI: 0.77–0.86). For harmful drinking in women, the AUDIT-C with weekend days

and the highest number of units had a higher sensitivity than the original AUDIT-C (95.7 against 94.9). However, specificity was higher with the original AUDIT-C (78.4 against 76.5), as well as the AUROC (0.87, 95% CI: 83–0.90).

Discussion

Different alternatives for the second question in the AUDIT-C, i.e., alcohol consumption on a typical day, were compared with the original question. The results show that the AUDIT-C in the original form is a valid screening instrument to identify hazardous and harmful drinkers, as defined by the AUDIT. The optimal cut-off point in the original AUDIT-C for hazardous drinking in men was 7 and in women was 6, and for harmful drinking, this was 8 and 7, respectively. For harmful drinking, the original AUDIT-C performed better than the alternative versions. Distinguishing alcohol consumption on weekend days and weekdays within the AUDIT-C did not produce better predictions of harmful drinkers.

Only for hazardous drinking in men, the AUDIT-C with a typical weekend day performed slightly better than the original AUDIT-C. There is thus a small difference in effectiveness in the investigated screening instruments between hazardous and harmful drinkers. Probably,

Table 4. Sensitivity, specificity, AUROC, and confidence interval for the alternatives AUDIT-C for the determined optimal cut-off AUDIT-C in identifying hazardous (AUDIT ≥ 8) and harmful (AUDIT ≥ 16) drinkers

| | Typical day | Weekday | Weekend day | Mean week/ weekend | Highest number | Lowest number | Most mentioned | Least mentioned |
|--|-------------|-------------|-------------|--------------------|----------------|---------------|----------------|-----------------|
| <i>Hazardous AUDIT ≥ 8</i> | | | | | | | | |
| Men (≥ 7) | | | | | | | | |
| Sensitivity | 84.9 | 89.9 | 84.2 | 84.9 | 84.2 | 89.9 | 82 | 89.2 |
| Specificity | 87.9 | 42.7 | 92.7 | 82.9 | 91.5 | 42.7 | 95.1 | 51.2 |
| AUROC | 0.878*** | 0.808*** | 0.887*** | 0.867*** | 0.881*** | 0.814*** | 0.884*** | 0.811*** |
| Confidence interval | 0.839–0.918 | 0.763–0.853 | 0.847–0.927 | 0.825–0.909 | 0.839–0.922 | 0.771–0.857 | 0.845–0.923 | 0.765–0.856 |
| Women (≥ 6) | | | | | | | | |
| Sensitivity | 84.5 | 70.7 | 84.8 | 84.2 | 84.8 | 70.7 | 83.5 | 72.1 |
| Specificity | 89.2 | 95.4 | 84.6 | 85.1 | 84.6 | 95.4 | 86.7 | 93.3 |
| AUROC | 0.869*** | 0.830*** | 0.847*** | 0.847*** | 0.847*** | 0.830*** | 0.851*** | 0.827*** |
| Confidence interval | 0.834–0.903 | 0.794–0.867 | 0.810–0.885 | 0.809–0.884 | 0.810–0.885 | 0.794–0.867 | 0.814–0.888 | 0.789–0.864 |
| <i>Harmful AUDIT ≥ 16</i> | | | | | | | | |
| Men (≥ 8) | | | | | | | | |
| Sensitivity | 85.6 | 64.9 | 85.6 | 78.4 | 83.8 | 65.8 | 81.1 | 67.6 |
| Specificity | 73.9 | 82.7 | 71.9 | 75.1 | 71.9 | 82.3 | 72.7 | 82.3 |
| AUROC | 0.814*** | 0.755*** | 0.809*** | 0.794*** | 0.805*** | 0.759*** | 0.793*** | 0.771*** |
| Confidence interval | 0.767–0.861 | 0.689–0.812 | 0.763–0.855 | 0.745–0.844 | 0.759–0.852 | 0.702–0.816 | 0.744–0.842 | 0.716–0.827 |
| Women (≥ 7) | | | | | | | | |
| Sensitivity | 94.9 | 86.3 | 95.7 | 92.3 | 95.7 | 86.3 | 94.9 | 87.2 |
| Specificity | 78.4 | 85.3 | 76.5 | 78.9 | 76.5 | 85.3 | 77.6 | 84.3 |
| AUROC | 0.866*** | 0.858*** | 0.861*** | 0.860*** | 0.861*** | 0.858*** | 0.862*** | 0.857*** |
| Confidence interval | 0.832–0.901 | 0.817–0.900 | 0.827–0.896 | 0.824–0.897 | 0.827–0.896 | 0.817–0.900 | 0.827–0.898 | 0.816–0.898 |

*** $p < 0.001$.

harmful drinkers show a higher consumption on most days of the week, so every day is a typical day. It is also possible that hazardous drinking men interpret a “typical day” differently than others.

Additionally, the results show that people mostly think about a weekend day when they have to answer the question about alcohol consumption on a typical day. Weekend days often correspond with the part of the week when people drink the most units of alcohol [22]. When using the original AUDIT-C, healthcare professionals should keep this in mind.

The original AUDIT-C, including the typical day question, performs well according to the results in our study, which is consistent with previous studies [9, 10]. A distinction between weekends and weekdays showed almost equally good sensitivity, specificity, and AUROC values. In practice, the additional advantage of the distinction is that it gives healthcare professionals more information about a person’s drinking pattern. The different effects of alcohol on the different days of the week will be visible, and the healthcare professional can use this

information in their advice [21, 24]. More information can serve as a better starting point for a discussion about someone’s drinking behaviour and can be useful to choose the most fitting intervention. However, the original AUDIT-C seemed to be most effective in predicting problematic use. There is thus a trade-off between an AUDIT-C with better predictions of whether someone is a hazardous or harmful drinker and an AUDIT-C containing more information about someone’s drinking patterns.

A consequence of changing the AUDIT is that the AUDIT(-C) becomes longer. The AUDIT would consist of 11 questions, and the AUDIT-C would consist of 4 questions. This is perceived as negative by healthcare professionals (and patients), who prefer to keep screenings as brief as possible [9]. Nevertheless, it is conceivable that completing this more extensive questionnaire takes just as long or even shorter because people have a better idea of what the question implies. It would be worthwhile to pilot the distinction among several populations to see whether it takes less time.

Limitations

In validation studies of shorter versions of the AUDIT, the most often used golden standard is the full AUDIT. With an average sensitivity of 0.86 and specificity of 0.89, this questionnaire is considered the best screening tool for early identification of problematic alcohol use [29]. A limitation of using the AUDIT in this study is that the AUDIT-C, and thus alcohol consumption, is part of the AUDIT, so the correlation is bound to be high. Future research should use a different, independent golden standard, for example, the Diagnostic and Statistical Manual of Mental Disorders (DSM). Another limitation of the present study is that the different questions about alcohol consumption and the AUDIT were asked in the same questionnaire. This can cause consistency response bias, which leads to (possibly unjustified) high correlations between the questions, inflating the performance of the screening instrument [9]. The research population consists of participants of “NoThanks,” which are people who voluntarily participate in the abstinence period and the questionnaires. Due to this self-selection, older and highly educated people are over-represented. Additionally, their alcohol consumption is based on self-reports, where the risks of underreporting are higher [7]. An advantage of this population is that they voluntarily participate to become aware of (the effect of) their alcohol use and are therefore more likely to answer the alcohol consumption questions truthfully. This can also be read from the fact that their reported weekly alcohol consumption is far above the Dutch average (around 8 units [30]). This study therefore gives a good idea of the effect of the distinction for heavy drinkers. It would be interesting to see how this works for a clinical population.

Conclusion

This study shows that the current AUDIT-C is a valid screening instrument and sensitive and specific enough to identify hazardous and harmful drinkers. A distinction between weekend- and weekday alcohol consumption in the AUDIT-C does not produce better predictions of problematic alcohol use. It would still be valuable to

further examine this version of the AUDIT-C, due to the fact that it performed almost equally as good and provides healthcare professionals with more knowledge about drinking patterns. These insights are valuable to improve the effectiveness and validity of the screening instrument.

Statement of Ethics

The Ethics Review Board of the Tilburg School of Social and Behavioral Sciences granted ethical approval for the study protocol, approval number TSB_RP229. All subjects received written information about the aim of the study, and participants participated voluntarily. Informed consent to participate was not directly obtained but inferred by completion of the questionnaire. All data were analysed anonymously.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Funding Sources

The study was supported by the Ministry of Health, Welfare and Sport (VWS).

Author Contributions

All authors were responsible for the study design. Rob H.L.M. Bovens collected the data. Annelien Esselink and Jolanda J.P. Mathijssen were responsible for the statistical analyses and interpretation of the data in agreement with all authors. Annelien Esselink, Rob H.L.M. Bovens, Dike H.M. van de Mheen, and Maurice J.W. Gesthuizen wrote the first version of the manuscript, and all authors participated in the revisions of the manuscript and read and approved the final article.

Data Availability Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

References

- 1 Rehm J, Shield KD. Alcohol and mortality: global alcohol-attributable deaths from cancer, liver cirrhosis, and injury in 2010. *Alcohol Res.* 2013;35(2):174–83.
- 2 Rehm J, Gmel GE Sr, Gmel G, Hasan OS, Imtiaz S, Popova S, et al. The relationship between different dimensions of alcohol use and the burden of disease: an update. *Addiction.* 2017;112(6):968–1001.
- 3 Hoskins R, Bengner J. What is the burden of alcohol-related injuries in an inner city emergency department? *Emerg Med J.* 2013; 30(3):e21.

- 4 Shield K, Manthey J, Rylett M, Probst C, Wettlaufer A, Parry CD, et al. National, regional, and global burdens of disease from 2000 to 2016 attributable to alcohol use: a comparative risk assessment study. *Lancet Public Health*. 2020;5(1):e51–61.
- 5 Madras BK, Compton WM, Avula D, Stegbauer T, Stein JB, Clark HW. Screening, brief interventions, referral to treatment (SBIRT) for illicit drug and alcohol use at multiple healthcare sites: comparison at intake and 6 months later. *Drug Alcohol Depend*. 2009;99(1–3):280–95.
- 6 Barata IA, Shandro JR, Montgomery M, Polansky R, Sachs CJ, Duber HC, et al. Effectiveness of SBIRT for alcohol use disorders in the emergency department: a systematic review. *West J Emerg Med*. 2017;18(6):1143–52.
- 7 Higgins-Biddle JC, Babor TF. A review of the alcohol use disorders identification test (AUDIT), AUDIT-C, and USAUDIT for screening in the United States: past issues and future directions. *Am J Drug Alcohol Abuse*. 2018;44(6):578–86.
- 8 Saunders JB, Aasland OG, Babor TF, De La Fuente JR, Grant M. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction*. 1993;88(6):791–804.
- 9 Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA, Project ACQI. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Arch Intern Med*. 1998;158(16):1789–95.
- 10 Tuunanen M, Aalto M, Seppä K. Binge drinking and its detection among middle-aged men using AUDIT, AUDIT-C and AUDIT-3. *Drug Alcohol Rev*. 2007;26(3):295–9.
- 11 Kools N, Van De Goor I, Bovens RH, Van De Mheen D, Rozema AD. Impeding and facilitating factors for the implementation of alcohol interventions in hospitals: a qualitative and exploratory study among Dutch healthcare professionals. *BMC Health Serv Res*. 2022;22(1):6–11.
- 12 Verhoog S, Dopmeijer JM, de Jonge JM, van der Heijde CM, Vonk P, Bovens RH, et al. The use of the alcohol use disorders identification test—Consumption as an indicator of hazardous alcohol use among university students. *Eur Addict Res*. 2020;26(1):1–9.
- 13 Babor TF, De La Fuente JR, Saunders J, Grant M. *AUDIT: guidelines for use in primary health care*. World Health Organization; 1992.
- 14 Bradley KA, DeBenedetti AF, Volk RJ, Williams EC, Frank D, Kivlahan DR. AUDIT-C as a brief screen for alcohol misuse in primary care. *Alcohol Clin Exp Res*. 2007;31(7):1208–17.
- 15 Saunders JB, Aasland OG, Organization WH. *WHO collaborative project on the identification and treatment of persons with harmful alcohol consumption. Report on phase I: the development of a screening instrument*. World Health Organization; 1987.
- 16 Fowler FJ Jr. How unclear terms affect survey data. *Public Opin Q*. 1992;56(2):218–31.
- 17 Graesser AC, Cai Z, Louwse MM, Daniel F. Question Understanding Aid (QUAID) a web facility that tests question comprehensibility. *Public Opin Q*. 2006;70(1):3–22.
- 18 Bovens RH, van de Mheen D. *Evaluating the recent ‘integrated approach’ to alcohol policy designed to promote moderate alcohol consumption among Dutch young people. Young adult drinking styles*. Palgrave Macmillan; 2019. p. 333–49.
- 19 Bovens R, Mathijssen J, van de Mheen H. *Evaluatie van IkPas in 2021*. Tranzo; 2021.
- 20 Kuntsche E, Cooper ML. Drinking to have fun and to get drunk: motives as predictors of weekend drinking over and above usual drinking habits. *Drug Alcohol Depend*. 2010;110(3):259–62.
- 21 Studer J, Baggio S, Mohler-Kuo M, Dermota P, Daeppen J-B, Gmel G. Differential association of drinking motives with alcohol use on weekdays and weekends. *Psychol Addict Behav*. 2014;28(3):651–8.
- 22 Lau-Barraco C, Braitman AL, Linden-Carmichael AN, Stamates AL. Differences in weekday versus weekend drinking among nonstudent emerging adults. *Exp Clin Psychopharmacol*. 2016;24(2):100–9.
- 23 Wilsnack RW, Vogeltanz ND, Wilsnack SC, Harris TR, Ahlström S, Bondy S, et al. Gender differences in alcohol consumption and adverse drinking consequences: cross-cultural patterns. *Addiction*. 2000;95(2):251–65.
- 24 Russell M, Light JM, Gruenewald PJ. Alcohol consumption and problems: the relevance of drinking patterns. *Alcohol Clin Exp Res*. 2004;28(6):921–30.
- 25 Selin KH. Alcohol Use Disorder Identification Test (AUDIT): what does it screen? Performance of the AUDIT against four different criteria in a Swedish population sample. *Subst Use Misuse*. 2006;41(14):1881–99.
- 26 Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. *The alcohol use Disorders identification test. Guidelines for use in primary care*. World Health Organization, Dependence DoMHaS; 2001.
- 27 Hanley J, McNeil BJ, McNeil BJ. The meaning and use of the area under a receiver operating characteristic (ROC) curve. *Radiology*. 1982;143(1):29–36.
- 28 Hosmer DW, Lemeshow S, Sturdivant RX. *Applied logistic regression*. John Wiley & Sons; 2013.
- 29 Reinert DF, Allen JP. The alcohol use disorders identification test: an update of research findings. *Alcohol Clin Exp Res*. 2007;31(2):185–99.
- 30 Leefstijl en (preventief) gezondheidsonderzoek; persoonskenmerken (Internet). May 16 2022 (cited June 20 2022). Available from: <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83021NED/table?dl=33FA4>.