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# An alternative alcohol use disorder screening tool in South Africa within set criteria

The Recall, Caution, Acting out, Excessive, Difficulty, Anxiety, Stress (RCAEDAS) screening tool was developed and validated to address limitations of existing alcohol use disorder screening instruments, particularly for diverse populations such as those in South Africa. We assessed the validity and reliability of the RCAEDAS using a cross-sectional design with 900 adult alcohol consumers across South Africa. Exploratory and confirmatory factor analyses supported a unidimensional structure with high internal consistency (Cronbach's $\alpha = 0.83$). The tool demonstrated excellent model fit (Comparative Fit Index (CFI) = 1.00, Tucker–Lewis Index (TLI) = 1.00, Root Mean Square Error of Approximation (RMSEA) = 0.00, Standardised Root Mean Square Residual (SRMR) = 0.00) and strong factor loadings, indicating good construct validity. Structural equation modelling revealed complex relationships between symptoms, with difficulty in daily functioning emerging as the strongest indicator of possible alcohol use disorder, followed equally by excessive drinking, anxiety and stress. The RCAEDAS showed high specificity (100%) and moderate sensitivity (45.7%) in identifying potential alcohol problems. Its focus on psychological impacts, behavioural changes and memory issues provides a more comprehensive assessment than existing tools that primarily emphasise consumption patterns. The strong psychometric properties and culturally sensitive approach of RCAEDAS suggest it may be a valuable addition to alcohol screening practices in South Africa and potentially other diverse populations, enabling earlier detection and intervention for alcohol use disorders.

**Significance:**

This study significantly contributes to addressing alcohol use disorders in South Africa. The RCAEDAS screening tool, developed and validated, offers a culturally sensitive and efficient method for identifying individuals at risk. Its strong psychometric properties and comprehensive symptom coverage make it valuable in clinical and research settings. The tool's brevity addresses the need for time-efficient screening in diverse populations. Insights from structural equation modelling deepen our understanding of the complex interrelationships between alcohol use disorder symptoms. This research provides a foundation for more targeted intervention strategies, potentially enhancing the management of alcohol-related health issues in South Africa and similar contexts.

## Background

Alcohol consumption causes approximately three million deaths annually worldwide and is linked to disabilities and poor health outcomes globally.[1-4] It accounts for 7.1% of the global disease burden in male individuals and 2.2% in female individuals.[1] Heavy alcohol consumption and dependency pose a significant threat to public health.[5] In South Africa, alcohol use is a major public health concern, with an estimated 7.5–31.5% of South Africans experiencing alcohol-related problems; female consumers consume 80% more alcohol than the global average for women.[6-8] One in 10 deaths in South Africa is alcohol related, highlighting the hazards of heavy use and potential dependency. Researchers have developed various screening tools to assess problematic alcohol consumption and related disorders, including the Alcohol Use Disorders Identification Test (AUDIT), Cut Annoyed Guilty Eye Opener (CAGE), and the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), which are widely used in South Africa.[9-13] While each of these tools offers certain benefits and limitations, they do not fully address the diverse range of alcohol use issues experienced by populations worldwide.

Most screening tools focus on consumption patterns as indicators of potential problems.[9] The problem with this is that alcohol affects people differently, and even moderate drinkers may be negatively affected by alcohol, because even drinking in moderation can hamper brain health and result in headaches and memory loss alike, appreciating that the risk of alcohol-related harm increases with higher levels of alcohol consumption.[14,15] The Recall, Caution, Acting out, Excessive, Difficulty, Anxiety, Stress (RCAEDAS) screening tool offers a novel approach to alcohol use disorder screening, particularly relevant for diverse populations such as those in South Africa. As illustrated in Table 1, compared to established tools such as AUDIT, CAGE and ASSIST, RCAEDAS uniquely focuses on psychological impacts, subtle behavioural changes and memory-related issues associated with drinking. It explicitly assesses stress and anxiety when not drinking, as well as difficulty abstaining during the day, thereby providing insight into psychological dependence.

Unlike other tools that focus on the frequency and quantity of alcohol consumption, RCAEDAS emphasises the consequences and experiences related to drinking. This symptom-focused approach may be more culturally sensitive and applicable across diverse populations with varying alcohol consumption norms.[10,16-26] RCAEDAS's holistic and concise approach combines elements from different established tools, making it suitable for the early identification of alcohol use disorders in diverse settings. Its focus on symptoms and behaviours rather than specific quantities may allow for more accurate detection of problematic alcohol use across different cultural and socioeconomic contexts within South Africa.

The primary objective of this study was to test the validity and reliability of the RCAEDAS screening tool for use in South Africa using appropriate statistical methods.

**Table 1:** RCAEDAS versus other alcohol-related problem screening tools

| Domain | RCAEDAS | AUDIT | CAGE | ASSIST |
|---|---|---|---|---|
| Memory/recall | Inability to recall events after drinking | – | – | – |
| Social feedback | Cautions from others about drinking behaviour | – | Annoyance by criticism of drinking | Others expressed concern about your alcohol use |
| Behavioural changes | Acting out of character due to drinking | – | – | – |
| Excessive use | Need to quit due to excessive drinking | Frequency of heavy drinking | Need to cut down on drinking | How often have you used alcohol *(past 3 months)* |
| Difficulty controlling use | Difficulty abstaining during the day | Inability to stop drinking | – | Failed to do what was normally expected of you because of alcohol use *(past 3 months)* |
| Withdrawal symptoms | Anxiety when not drinking | – | – | Experienced health, social, legal or financial problems due to alcohol use *(past 3 months)* |
| Psychological impact | Stress when not drinking | Feeling guilty after drinking | Guilty feelings about drinking | – |
| Frequency of use | | Frequency of drinking | – | How often have you used alcohol *(past 3 months)* |
| Quantity of use | | Typical quantity | – | – |
| Morning drinking | | Morning drinking | Eye-opener drinks | – |
| Impact on responsibilities | | Failing to meet expectations due to drinking | – | Failed to do what was normally expected of you because of alcohol use *(past 3 months)* |
| Craving | | – | – | Strong desire or urge to use alcohol *(past 3 months)* |
| Reduced activities | | – | – | – |
| Hazardous use | | Injuries resulting from drinking | – | Injection of drugs *(past 3 months and other frequency of injection questions)* |
| Tolerance | | Increased drinking to get the same effect | – | – |
| Impact on memory/ concentration | | – | – | Has your alcohol use led to memory or concentration problems |
| Attempted cessation | | – | – | Have you ever tried and failed to control, cut down or stop using alcohol |

## Methodology

This study employed a cross-sectional design to assess the validity and reliability of the RCAEDAS screening tool in South Africa.

### *Participants*

A total of 900 adult alcohol consumers from across South Africa participated in this study. Participants were selected from a larger survey population. Specifically, individuals who reported consuming alcohol within the past 12 months were extracted from the broader survey sample to form the study cohort. Participants were selected using a stratified random sampling approach to ensure representativeness across different demographic groups and geographic regions within South Africa. The researchers employed a split-sample design, dividing the participants into two random subsamples of 450 each. One subsample was used for exploratory factor analysis (EFA), while the other was utilised for confirmatory factor analysis (CFA). Both sample sizes were deemed more than sufficient for these analyses.[27-30]

### *Materials and procedure*

The RCAEDAS screening tool includes seven statements that evaluate symptoms related to potential alcohol use disorder or dependence. Its development involved a comprehensive process of item selection and refinement. A thorough literature review identified the main factors driving alcohol use, guiding item choice. Consultation with a medical practitioner and a tool design expert experienced in alcohol screening informed the development process. The selection process also drew insights from common screening instruments, aiming to address gaps, particularly for diverse populations. A pilot phase ensured clarity across various demographic groups, leading to improved wording and cultural appropriateness.

Local fieldworkers approached potential participants in their communities and obtained informed consent as part of the study's inclusion criteria. Data were anonymised and stored on encrypted computers to ensure privacy and protection. To ensure cross-cultural validity, the tool was carefully translated and administered in six widely spoken South African languages:

English, Zulu, Xhosa, Sepedi, Sotho and Afrikaans. The translation process considered linguistic and cultural nuances, ensuring easy comprehension and minimising potential misinterpretation or cultural bias.

Ethical clearance to conduct this study was obtained from the Wits Human Research Ethics Committee (Non-Medical), which approved the study and issued ethics clearance (number H23/08/09). Data collection was conducted face-to-face across all South African provinces using a random probability approach, ensuring a representative sample of the diverse population.

Participation was voluntary and consensual, with respondents reporting good comprehension of the questions across all language versions. Notably, as confirmed during the pilot phase, participants who identified as drinkers did not express any offence or discomfort with the questions, suggesting the cultural appropriateness of the tool. The tool uses a 5-point Likert scale ranging from 1 (Strongly disagree) to 5 (Strongly agree) for each statement. Total scores range from 7 to 35, with higher scores indicating a greater probability of problematic alcohol use. To facilitate interpretation and risk assessment, the tool employs a tiered categorisation system. Scores between 1 and 7 suggest low risk, scores between 8 and 13 indicate moderate risk, scores between 14 and 17 point to possible heavy alcohol use, warranting closer attention, and scores of 18 and above signal possible dependency, highlighting the need for immediate intervention.

This self-administered tool, with its multilingual availability and culturally sensitive approach, aims to provide a valid and reliable screening method for alcohol use disorders across diverse South African populations.

### *Data analysis*

#### Exploratory factor analysis (subsample 1)

EFA was conducted in Jamovi on random subsample 1 ($n = 450$) to determine the initial structure of the RCAEDAS. The eigenvalue method was employed to identify the number of factors to retain, and a scree plot was used to graphically illustrate the eigenvalues and factor structure. The final factor structure was established using the following criteria:

a. Factors with eigenvalues of ≥1 were retained.

b. Only factors above the elbow point in the scree plot were retained, as recommended by several studies.[31-33]

c. Multi-item factors were required to demonstrate adequate internal consistency, with a Cronbach's alpha coefficient of ≥0.70, which is deemed acceptable, while values exceeding 0.90 were indicative of excellent internal consistency.[34-37]

#### Checking assumptions of the EFA

Before proceeding with the EFA, the authors verified the prerequisites for the factorability of the correlation matrix. First, we utilised Bartlett's test of sphericity, as noted by Dabbagh and colleagues in 2023, confirming that the matrix was structured and not random or due to chance.[29] Subsequently, the Kaiser–Meyer–Olkin (KMO) test for sampling adequacy was employed, with a necessary threshold of over 0.5 for each variable.[29]

#### Examining the construct validity: EFA

Upon checking the assumptions of the EFA, the authors conducted the EFA using the factor package in Jamovi 2 statistical software. We employed promax rotation, an oblique rotation method, as we anticipated that the factors within the RCAEDAS screening tool would be intercorrelated, as informed by earlier-discussed literature. We extracted factors using the maximum likelihood estimation method, which is appropriate for normally distributed data and provides goodness-of-fit indices.

#### Confirmatory factor analysis (subsample 2)

Subsequently, the resulting model was tested using CFA with random subsample 2 ($n = 450$) to prevent the effects of capitalisation on chance.[29] The CFA was conducted using STATA's structural equation modelling (SEM) builder. Model fit was assessed using various indices (CFI/TLI > 0.95, RMSEA/SRMR < 0.10).[38-41] Both unstandardised and standardised path coefficients were calculated and reported to provide a comprehensive understanding of the relationships between variables. Unstandardised coefficients represent the raw relationships between variables, while standardised coefficients allow for easier comparisons across different measures.

In addition to assessing model fit, we calculated McDonald's omega to establish internal consistency reliability. McDonald's omega is considered a more robust measure of internal consistency than Cronbach's alpha, especially when the assumption of tau-equivalence is violated. McDonald's omega was computed using the factor loadings and error variances obtained from the CFA model.

## Results

### *Background characteristics of study respondents*

The study participants were predominantly young to middle-aged adults, with 84% being younger than 46 years of age (24% aged 18–25 years; 35% 26–35; 25% 36–45). Older age groups were less represented, with 10% aged 46–55 years, 5% aged 56–65 years and only 2% aged 66 years and older. There was a slight gender imbalance (57% male, 43% female). Geographically, Gauteng had the highest representation (22%), followed by KwaZulu-Natal (16%) and Mpumalanga (14%). The North West and Eastern Cape each accounted for 24%, Limpopo for 8%, Western Cape for 7% and both the Northern Cape and Free State for 5% each. Racially, the participants were predominantly black (91%), with fewer coloured (7%) and white (2%) participants and no Indian/Asian participants (0%). Most respondents (71%) lived in urban areas versus 29% in rural areas. Employment status was nearly evenly split (51% employed, 49% unemployed). Marital status showed that a significant majority (82%) were unmarried, while only 18% were married.

**Table 2:** RCAEDAS possible alcohol dependency screening tool

| Statement | Strongly disagree | Disagree | Neither agree nor disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Drinking alcohol has made me unable to **recall** what happened the previous day on the next day. | 1 | 2 | 3 | 4 | 5 |
| Friends, family members and other people have **cautioned** me about my drinking behaviour. | 1 | 2 | 3 | 4 | 5 |
| I have **acted** out of character because of drinking alcohol. | 1 | 2 | 3 | 4 | 5 |
| I have felt the need to quit alcohol because of **excessive** drinking. | 1 | 2 | 3 | 4 | 5 |
| I have had **difficulty** going through the day without drinking alcohol. | 1 | 2 | 3 | 4 | 5 |
| I feel **anxious** when I do not drink alcohol for long periods of time. | 1 | 2 | 3 | 4 | 5 |
| I feel **stressed** when I do not drink alcohol. | 1 | 2 | 3 | 4 | 5 |

### *EFA results*

Bartlett's test of sphericity results showed that the correlation matrix was not due to chance or randomness ($x^2 = 1050$; $p < 0.001$). Furthermore, the KMO measure of sampling adequacy ranged from 0.82 to 0.90 across all items, yielding an overall KMO value of 0.86, surpassing the minimum sampling adequacy requirements for conducting EFA.[37]

The eigenvalue method and the scree plot suggested one factor be retained, as indicated in Table 3 and Figure 1. The factor was labelled "possible alcohol use disorder or dependency" (PAUDoD) , because the statements provided in the screening tool (see Table 2) all related to symptoms of PAUDoD.[42]

The scree plot presented in Figure 1 visually reaffirms the retention of one factor, as suggested by the eigenvalue method, by displaying the eigenvalues and considering those greater than 1 as suitable for retention.

### Internal consistency: Reliability

The overall Cronbach's $\alpha$ coefficient for the screening tool was 0.83, indicating strong internal consistency.[43-46]

**Table 3:** Factor loadings for possible alcohol use disorder or dependency

| Statements | Symptoms of possible alcohol use disorder or dependency | Uniqueness |
|---|---|---|
| | Factor 1 | |
| S1 – Drinking alcohol has made me unable to recall what happened the previous day on the next day | **0.64** | 0.59 |
| S2 – Friends, family members and other people have cautioned me about my drinking behaviour | **0.64** | 0.58 |
| S3 – I have acted out of character because of drinking alcohol | **0.64** | 0.58 |
| S4 – I have felt the need to quit alcohol because of excessive drinking | **0.55** | 0.69 |
| S5 – I have had difficulty going through the day without drinking alcohol | **0.67** | 0.55 |
| S6 – I feel anxious when I do not drink alcohol for long periods of time | **0.70** | 0.51 |
| S7 – I feel stressed when I do not drink alcohol | **0.71** | 0.49 |

*Note: Principal axis extraction method was used in combination with 'promax' rotation. Factor loadings of >0.4 were considered important and correlated with the factor.*

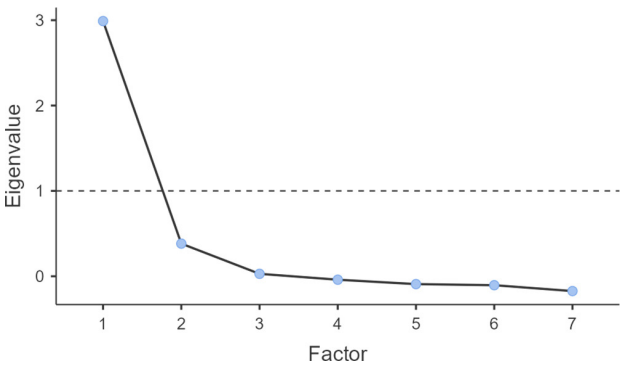


**Figure 1:** Scree plot for the retention of one factor.

### *Confirmatory factor analysis*

As illustrated in Table 4, the CFA confirmed the single-factor model, with good-fit indices ($x^2 < 5$; RMSEA < 0.06 / SRMR < 0.08; CFI > 0.95, TFI > 0.95). All items showed statistically significant loadings ($p < 0.001$), suggesting they are reliable indicators of the latent construct of PAUDoD.

As shown in Table 5, the CFA results reveal the relative importance of the various symptoms in indicating a latent factor, which in this case represents PAUDoD. All items showed statistically significant loadings ($p < 0.001$), suggesting they are reliable indicators of this latent construct.

The inability to recall events from the previous day after drinking (Recall) served as the reference item for the unstandardised factor loading (UL: 1.00) and demonstrated a moderate standardised factor loading

**Table 4:** Model fit indices for the possible alcohol use disorder or dependency screening tool

| Index | Cut-off criteria (accepted values) | Model results | References |
|---|---|---|---|
| Chi-squared | <5 | 3.02 | Whittaker and Schumacker[47], Abrahim et al.[48] |
| Root Mean Square Error of Approximation (RMSEA) | <0.06 | 0.00 | Leal-Soto and Ferrer-Urbina[38], Shi et al.[40], Pan and Liu[41] |
| Standardised Root Mean Square Residual (SRMR) | <0.08 | 0.00 | Shi et al.[40], Pan and Liu[41] |
| Comparative Fit Index (CFI) | >0.95 | 1.00 | Leal-Soto and Ferrer-Urbina[38], Schreiber et al.[39], Pan and Liu[41] |
| Tucker–Lewis Index (TLI) | >0.95 | 1.00 | Leal-Soto and Ferrer-Urbina[38], Schreiber et al.[39], Pan and Liu[41] |

**Table 5:** Unstandardised and standardised factor loadings for possible alcohol use disorder or dependency with RCAEDAS

| Measurement | Unstandardised loading (SE) | *p*-value | Standardised loading | *p*-value |
|---|---|---|---|---|
| Recall (reference item**) | 1 | | 0.60 (0.04) | 0.00*** |
| Caution | 1.00 (0.10) | 0.00*** | 0.57 (0.04) | 0.00*** |
| Acting out of character or behavioural change | 0.89 (0.09) | 0.00*** | 0.54 (0.04) | 0.00*** |
| Excessive | 1.15 (0.20) | 0.00*** | 0.66 (0.07) | 0.00*** |
| Difficulty | 1.07 (0.12) | 0.00*** | 0.73 (0.03) | 0.00*** |
| Anxiety | 1.01 (0.11) | 0.00*** | 0.66 (0.03) | 0.00*** |
| Stress | 0.95 (0.12) | 0.00*** | 0.66 (0.04) | 0.00*** |

*** $p < 0.001$; $n = 450$

*SE, standard error*

(SL: 0.60, standard error [SE]: 0.04, $p < 0.001$). Difficulty functioning without alcohol emerged as the strongest indicator (UL: 1.07, SL: 0.73, $p < 0.001$), followed closely by excessive drinking (UL: 1.15, SL: 0.66, $p < 0.001$) and anxiety (UL: 1.01, SL: 0.66, $p < 0.001$). Stress also showed a strong association (UL: 0.95, SL: 0.66, $p < 0.001$). Acting out of character or behavioural change (UL: 0.89, SL: 0.54, $p < 0.001$) and cautions from others (UL: 1.00, SL: 0.57, $p < 0.001$) demonstrated moderate associations with the latent factor.

These results indicate that while all symptoms are significant indicators of the latent factor (all $p < 0.001$), difficulty abstaining, excessive drinking, anxiety and stress associated with not drinking are particularly strong markers of PAUDoD. The high standardised loadings across all items (ranging from 0.54 to 0.73) suggest that each symptom contributes substantially to the measurement of the underlying construct.

## RCAEDAS pathways affecting alcohol use disorder risk

Additionally, as part of the analysis, we tested an SEM using Stata to explain the pathways through which recall, caution, acting out or behavioural change, excessive drinking, difficulty, anxiety and stress affect PAUDoD in South Africa.

The SEM revealed complex interrelationships among RCAEDAS variables, with direct effects equivalent to total effects due to the absence of mediating variables (see Figures 2 and 3 for the unstandardised and standardised pathways to PAUDoD in South Africa). As illustrated in Table 6, difficulty in daily functioning emerged as the strongest indicator of PAUDoD ($b = 1.07$; $\beta = 0.73$, $p < 0.001$), followed by excessive drinking ($b = 1.15$; $\beta = 0.66$, $p < 0.001$), anxiety ($b = 1.01$; $\beta = 0.66$, $p < 0.001$) and stress ($b = 0.95$; $\beta = 0.66$, $p < 0.001$). Recall-related issues also showed a strong association with PAUDoD ($\beta = 0.60$, $p < 0.001$), as did cautions from others ($b = 1.00$; $\beta = 0.57$, $p < 0.001$).

Acting out or behavioural change demonstrated a moderate-to-strong relationship with PAUDoD ($b = 0.89$; $\beta = 0.54$, $p < 0.001$).

As illustrated in Table 7, the model also revealed several significant covariances between error terms; particularly noteworthy were the negative covariances between Excessive drinking and several other variables. The covariance between Excessive drinking and Difficulty was significant and negative (unstandardised covariance = −0.26, 95% confidence interval [CI]: −0.45 to −0.07, $p < 0.01$; standardised covariance = −0.38, SE = 0.17, 95% CI: −0.73 to −0.03, $p < 0.05$). Similarly, significant negative covariances were observed between Excessive drinking and Anxiety (unstandardised covariance = −0.21, 95% CI: −0.39 to −0.04, $p < 0.01$; standardised covariance = −0.27, SE = 0.13, 95% CI: −0.54 to −0.01, $p < 0.05$) and between Excessive drinking and Stress (unstandardised covariance = −0.24, 95% CI: −0.42 to −0.06, $p < 0.01$; standardised covariance = −0.32, SE = 0.15, 95% CI: −0.62 to −0.02, $p < 0.05$).

Positive covariances were also observed, particularly between Recall and Caution (unstandardised covariance = 0.16, 95% CI: 0.02–0.31, $p < 0.05$; standardised covariance = 0.16, SE = 0.06, 95% CI: 0.04–0.28, $p < 0.01$), Recall and Acting out/Behavioural Change (unstandardised covariance = 0.19, 95% CI: 0.06–0.32, $p < 0.001$; standardised covariance = 0.19, SE = 0.05, 95% CI: 0.07–0.31, $p < 0.001$) and Anxiety and Stress (unstandardised covariance = 0.16, 95% CI: 0.06–0.26, $p < 0.01$; standardised covariance = 0.24, SE = 0.06, 95% CI: 0.12–0.37, $p < 0.001$). These covariances suggest complex interrelationships among the variables, with excessive drinking showing unique negative associations with difficulty, anxiety and stress, while other symptoms demonstrate positive relationships with each other.

To further assess the reliability of the RCAEDAS, we calculated McDonald's omega based on the CFA results. The analysis yielded a McDonald's omega of 0.99939159, indicating exceptionally high internal consistency reliability. This result suggests that the RCAEDAS items are very strongly interrelated and measure a common underlying construct of PAUDoD.

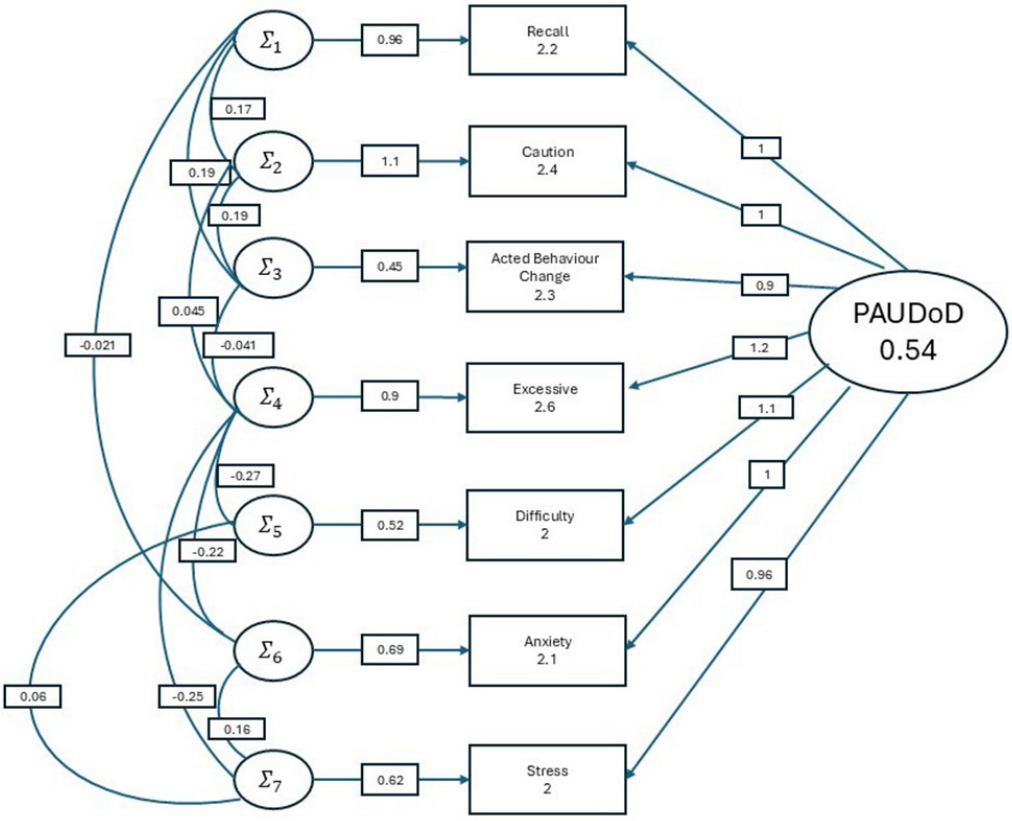


**Figure 2:** Unstandardised pathways to possible alcohol use disorder or dependency in South Africa.

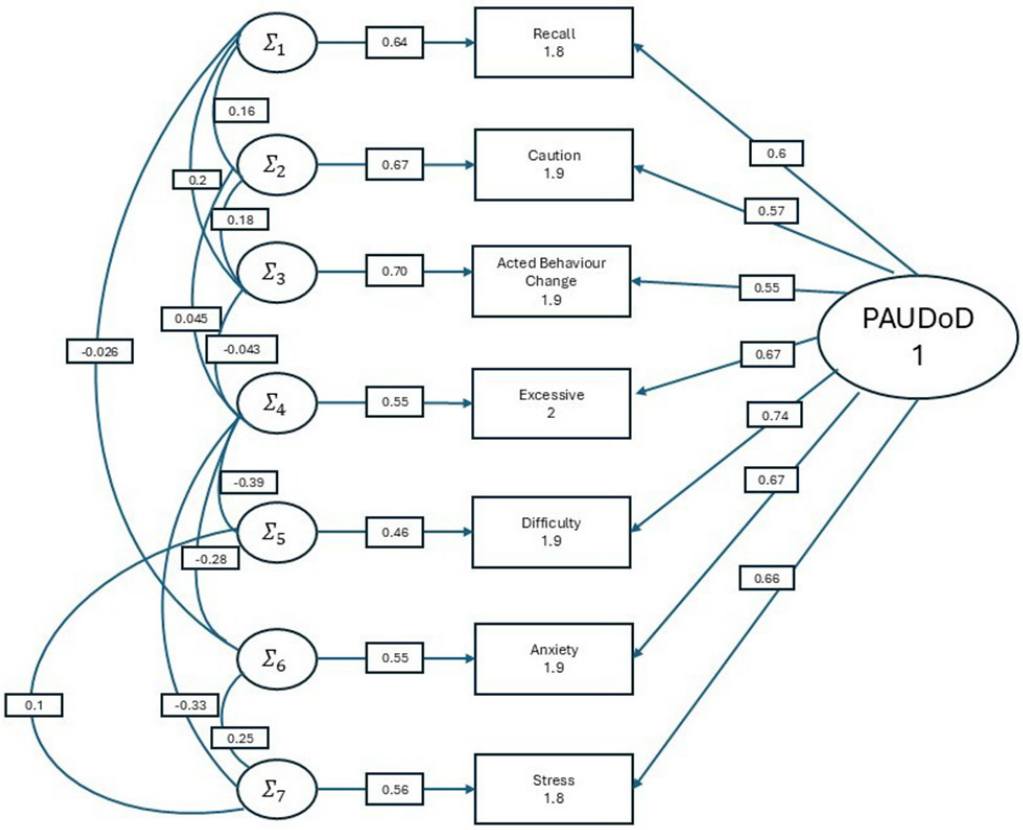


**Figure 3:** Standardised pathways to possible alcohol use disorder or dependency in South Africa.

**Table 6:** Part A: Pathway coefficients

| Path coefficients | Unstandardised *b* (SE) | *p*-value | 95% CI | Standardised $\beta$ (SE) | *p*-value | 95% CI |
|---|---|---|---|---|---|---|
| PAUDoD → Recall | 1.00 (–) | – | – | 0.60 (0.04) | 0.000*** | 0.50–0.69 |
| PAUDoD → Caution | 1.00 (0.10) | 0.000*** | 0.80–1.21 | 0.57 (0.04) | 0.000*** | 0.48–0.66 |
| PAUDoD → Acting behaviour change | 0.89 (0.09) | 0.000*** | 0.71–1.08 | 0.54 (0.04) | 0.000*** | 0.45–0.63 |
| PAUDoD → Excessive | 1.15 (0.20) | 0.000*** | 0.74–1.56 | 0.66 (0.07) | 0.000*** | 0.51–0.81 |
| PAUDoD → Difficulty | 1.07 (0.12) | 0.000*** | 0.82–1.32 | 0.73 (0.03) | 0.000*** | 0.65–0.81 |
| PAUDoD → Anxiety | 1.01 (0.11) | 0.000*** | 0.79–1.23 | 0.66 (0.03) | 0.000*** | 0.59–0.74 |
| PAUDoD → Stress | 0.95 (0.11) | 0.000*** | 0.70–1.20 | 0.66 (0.04) | 0.000*** | 0.56–0.75 |

b, *unstandardised coefficient; PAUDoD, possible alcohol use disorder or dependency; SE, standard error; CI, confidence interval;* β, *standardised coefficient*

*** $p < 0.001$ *(for both unstandardised and standardised p-values)*

### *Sensitivity and specificity analysis*

To further evaluate the utility of the RCAEDAS as a screening tool, we conducted a sensitivity and specificity analysis using a proxy measure derived from the RCAEDAS scores.

The RCAEDAS demonstrated excellent specificity of 100% (95% CI: 97.9–100), indicating that the tool correctly identified all true-negative cases in our sample. This finding suggests a very low false-positive rate, which is particularly valuable in screening tools because it minimises the risk of unnecessarily alarming individuals or recommending further assessment for those who don't need it. The sensitivity of the RCAEDAS was 45.7% (95% CI: 39.7–51.7). Although lower than its specificity, this moderate sensitivity indicates that the tool identifies nearly half of the true-positive cases, which can be useful for initial identification of potential alcohol-related problems.

The positive predictive value of 100% (95% CI: 97.1–100) suggests that all individuals identified as positive by the RCAEDAS were also classified as positive according to our proxy gold standard. The negative predictive value of 53.3% (95% CI: 47.6–58.8) indicates that about half of the individuals who tested negative were truly negative. The ROC area of 0.73 (95% CI: 0.70–0.76) suggests good overall discriminative ability of the RCAEDAS, performing better than chance in distinguishing between positive and negative cases. These results provide additional support for the utility of the RCAEDAS as a screening tool, particularly in its ability to correctly identify negative cases and in its overall discriminative ability.

## Discussion

The EFA and CFA strongly support a unidimensional structure for the RCAEDAS. This suggests that the seven items in the tool are measuring

**Table 7:** Part B: Error covariances

| Covariance | Unstandardised estimate (SE) | *p*-value | 95% CI | Standardised estimate (SE) | *p*-value | 95% CI |
|---|---|---|---|---|---|---|
| e.Recall ↔ e.Caution | 0.16 (0.07) | 0.02* | 0.02–0.31 | 0.16 (0.06) | 0.01** | 0.04–0.28 |
| e.Recall ↔ e.Acted_Behaviour_Change | 0.19 (0.06) | 0.00*** | 0.06–0.32 | 0.19 (0.05) | 0.000** | 0.07–0.31 |
| e.Recall ↔ e.Anxiety | −0.02 (0.04) | 0.66 | −0.11 to 0.07 | −0.02 (0.06) | 0.67 | −0.14 to 0.09 |
| e.Caution ↔ e.Acted_Behaviour_Change | 0.18 (0.06) | 0.01** | 0.05–0.32 | 0.17 (0.05) | 0.00*** | 0.06–0.28 |
| e.Caution ↔ e.Excessive | 0.04 (0.08) | 0.59 | −1.12 to 0.21 | 0.04 (0.08) | 0.58 | −0.11 to 0.20 |
| e.Acted_Behaviour_Change ↔ e.Excessive | −0.04 (0.07) | 0.59 | −0.19 to 0.10 | −0.04 (0.08) | 0.60 | −0.20 to 0.12 |
| e.Excessive ↔ e.Difficulty | −0.26 (0.09) | 0.01** | −0.45 to −0.07 | −0.38 (0.17) | 0.00* | −0.73 to −0.03 |
| e.Excessive ↔ e.Anxiety | −0.21 (0.08) | 0.01** | −0.39 to −0.04 | −0.27 (0.13) | 0.00* | −0.54 to −0.01 |
| e.Excessive ↔ e.Stress | −0.24 (0.09) | 0.01** | −0.42 to −0.06 | −0.32 (0.15) | 0.00* | −0.62 to −002 |
| e.Difficulty ↔ e.Stress | 0.05 (0.05) | 0.24 | −0.04 to 0.16 | 0.10 (0.08) | 0.20 | −0.05 to 0.26 |
| e.Anxiety ↔ e.Stress | 0.16 (0.05) | 0.00** | 0.06–0.26 | 0.24 (0.06) | 0.000*** | 0.12–0.37 |

*SE, standard error; CI, confidence interval*

** $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$*

a single underlying construct of PAUDoD. The high internal consistency (Cronbach's $\alpha = 0.82$) further reinforces the reliability of the scale. These findings indicate that the RCAEDAS is a cohesive and reliable measure of alcohol-related problems within the South African context. The excellent model fit indices obtained from the CFA ($x^2 = 3.91$, RMSEA = 0.01, SRMR = 0.00, CFI = 1.00, TLI = 0.99) provide robust evidence for the construct validity of the RCAEDAS. This suggests that the tool accurately reflects the theoretical construct of PAUDoD, enhancing its utility in both research and clinical settings. A key finding concerns the relative importance of different symptoms in indicating a PAUDoD. Excessive drinking emerged as the strongest indicator (standardised loading = 0.82), followed closely by stress when not drinking (0.75) and difficulty abstaining (0.74). This finding aligns with established diagnostic criteria for alcohol use disorders and underscores the central role of compulsive drinking and withdrawal symptoms in alcohol dependency.[49]

Our findings regarding the higher weighting assigned to the excessive drinking item in the RCAEDAS (standardised loading = 0.82) align with and extend the approach adopted by other established alcohol-use disorder screening instruments. For instance, this result echoes the emphasis placed on consumption patterns in the first three items of the AUDIT and the Alcohol Use Disorders Identification Test–Consumption.[10] However, the RCAEDAS goes beyond mere consumption patterns by incorporating psychological and behavioural aspects associated with excessive drinking. This comprehensive approach allows for a more nuanced assessment of alcohol use problems, potentially capturing individuals who may not be identified by consumption-focused measures alone. The strong loading of the excessive drinking item, combined with high loadings for stress and difficulty abstaining, suggests that the RCAEDAS may be particularly sensitive to the transition from heavy drinking to dependence, a critical point for intervention.[50,51]

These statistical findings provide a strong foundation for understanding the RCAEDAS's potential impact on alcohol use disorder screening practices. Building on these results, we can now examine how the RCAEDAS addresses existing gaps in the field.

The development and validation of the RCAEDAS addresses a significant gap in existing research on alcohol use disorder screening tools, particularly in diverse populations such as those found in South Africa. While established instruments such as AUDIT, CAGE and ASSIST have been widely used, they often lack cultural sensitivity and may not fully capture the nuanced experiences of alcohol-related problems across different cultural contexts.[10,12,13] For instance, AUDIT primarily focuses on consumption patterns and consequences, whereas CAGE emphasises feelings of guilt and the need to cut down on drinking. In contrast, the RCAEDAS's unique focus on psychological impacts (stress and anxiety), subtle behavioural changes (acting out of character), and memory-related issues associated with drinking provides a more comprehensive assessment that is especially relevant in the South African context. This holistic approach allows for a more nuanced understanding of alcohol use problems that may be particularly valuable in culturally diverse settings.[52]

This study advances the field by introducing a brief, culturally sensitive screening tool that combines elements from existing instruments while addressing their limitations. The RCAEDAS's strong psychometric properties, demonstrated through rigorous statistical analyses, suggest that it may be a valuable addition to both clinical practice and research settings.

The SEM results further emphasise the importance of excessive drinking as the strongest predictor of PAUDoD. The strong direct effects of stress, difficulty abstaining, and anxiety on the latent construct highlight the multifaceted nature of alcohol use problems, encompassing both behavioural and psychological components. Interestingly, the significant negative covariances between excessive drinking and difficulty, anxiety and stress present a complex picture. These relationships suggest that the unexplained variance in these other symptoms decreases as excessive drinking increases. This could indicate that excessive drinking might overshadow or mask the experience of these other symptoms in individuals with severe alcohol use problems. Alternatively, it might suggest that individuals who drink excessively may not perceive or report difficulties, anxiety or stress related to their drinking, possibly due to denial or impaired insight.[53] These findings build upon previous research on the complex interplay of symptoms in alcohol use disorders, such as the work of Maurage and colleagues who found that individuals with severe alcohol use disorder often exhibit reduced emotional awareness and increased alexithymia, which may obscure their perception of stress or anxiety.[54]

The findings of this study have significant implications for alcohol use disorder screening and intervention in South Africa and potentially other diverse populations. The RCAEDAS's ability to detect subtle indicators of problematic alcohol use, such as psychological dependence and behavioural changes, may allow for earlier identification and intervention. This is particularly important in a country like South Africa, where alcohol-related problems contribute significantly to the public health burden.[6-8] By enabling earlier detection, the RCAEDAS could potentially reduce the progression of alcohol use disorders and associated health complications, leading to improved public health outcomes and reduced healthcare costs.[55]

Furthermore, the complex interrelationships revealed by the SEM provide new insights into the nature of alcohol use disorders. The negative covariances between excessive drinking and other symptoms (difficulty abstaining, anxiety and stress) suggest a nuanced picture of how these factors interact in the development and maintenance of alcohol-related problems. These findings extend our understanding beyond the linear progression models of alcohol use disorders, aligning with recent research emphasising the dynamic and multifaceted nature of addiction.[50] Such insights may inform more targeted intervention strategies that address the multifaceted nature of alcohol use disorders, potentially improving treatment efficacy and outcomes.

In the broader context of alcohol research, this study contributes to the ongoing discussion about the need for culturally adapted screening tools. The success of the RCAEDAS in the South African context demonstrates the value of developing instruments that are sensitive to local drinking patterns and cultural norms. This approach may serve as a model for future efforts to create screening tools tailored to other diverse populations worldwide.

### *Strengths and limitations*

A key strength of this study is its large, diverse sample ($N = 900$), drawn from across South Africa, enhancing the generalisability of the findings. The use of rigorous statistical methods, including EFA, CFA and SEM, provides a comprehensive evaluation of the RCAEDAS's psychometric properties. The split-sample approach, using separate subsamples for EFA and CFA, further strengthens the validity of our results.

However, several limitations should be noted. The cross-sectional nature of the data limits our ability to assess the tool's predictive validity over time. Longitudinal studies would be valuable in establishing the RCAEDAS's ability to predict future alcohol-related problems as well as strengthen the SEM. Additionally, future research should focus on comparing the RCAEDAS with existing widely used tools such as the AUDIT, CAGE, and ASSIST. Such comparative studies would help establish the relative sensitivity and specificity of the RCAEDAS in detecting alcohol use disorders across different populations and settings. Furthermore, investigating how the RCAEDAS performs on these established measures could provide insights into its unique contributions to alcohol screening practices, particularly in diverse cultural contexts like South Africa. It would also be crucial to assess the test–retest reliability of the RCAEDAS over different time intervals, which would provide valuable information about the stability of the measure and its ability to consistently identify alcohol use problems over time. Additionally, the study relied on self-reported data, which may be subject to recall bias or social desirability effects, particularly given the sensitive nature of alcohol use.

## Conclusion

The RCAEDAS represents a significant advancement in alcohol use disorder screening, particularly for diverse populations. Its unique combination of brevity, comprehensive symptom coverage and cultural sensitivity addresses critical gaps in existing screening tools. As global health initiatives increasingly recognise the importance of tailored approaches to mental health and substance use disorders, tools such as the RCAEDAS are poised to play a crucial role in improving early detection and intervention strategies worldwide.

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## Data availability

The data supporting the results of this study are available upon request to the corresponding author.

## Declarations

We have no competing interests to declare. We have no AI or LLM use to declare. Ethical clearance to conduct this study was obtained from the Human Research Ethics Committee (Non-Medical) of the University of the Witwatersrand (ethics clearance number H23/08/09).

## Authors' contributions

M.H.: Methodology, investigation, formal analysis, sample analysis, validation, writing – original draft, writing – review and editing. D.S.R.: Conceptualisation, methodology, project leadership, project administration, funding acquisition. E.N.: Investigation, project administration. All authors read and approved the final manuscript.

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