Psychometric evaluation of a Swedish version of the Impaired Control Scale for individuals with alcohol use disorder

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Abstract
Aim: The aim of this study was to evaluate the psychometric properties of a Swedish version of the Impaired Control Scale. Impaired control (IC) over alcohol consumption is a core symptom of

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alcohol use disorder and a predictor of treatment outcome, but measures of IC are not well utilised in clinical practice. **Methods:** The study comprised 250 individuals from a randomised controlled trial conducted at an adult outpatient addiction clinic in Sweden. The statistical analyses concern dimensionality, convergent and divergent validity, reliability, measurement invariance and sensitivity to change. **Results:** Regarding dimensionality, a principal component analysis of the standardised residuals from a Rasch model indicated some evidence of further dimensions underlying the responses in the Failed Control (FC) and Perceived Control (PC) parts. Two parallel items (12 and 22 respectively) seemed to drive potential multidimensionality. When these items were excluded, goodness of fit to one-dimensional models was improved. Tests of convergent and divergent validity showed that failed control had the strongest associations to impaired control and alcohol use disorder while the attempted control part was not associated with the construct of impaired control or alcohol use disorder. **Conclusion:** The present results show that the FC part is the most valid measure of the underlying construct of IC. In addition, FC had close to a large effect in regard to sensitivity to change. This suggests that the FC part has potential utility for use as an assessment and evaluation tool of treatment effect on impaired control of drinking.

Impaired control (IC) over alcohol consumption has repeatedly been described as a key feature of alcohol use disorder (AUD) and is clinically manifested as difficulties in abstaining and limiting the amount of alcohol consumed in a given situation. In the *Diagnostic and statistical manual of mental disorders* (5th ed.) (American Psychiatric Association, 2013), IC is represented by two criteria: "the substance is often taken in larger amounts or over a longer period than was intended" and "a persistent desire or unsuccessful efforts to cut down or control substance use" (p.490).

The theoretical conceptualisation of IC in relation to alcohol dependence was originally described by Jellinek in his characterisation of subtypes of alcoholism, namely: (1) "Gamma-type" which was characterised by difficulties in loss of control over the amount consumed, and (2) "Delta-type", who did not experience loss of control, but had difficulties in abstaining from alcohol for longer periods (Jellinek, 1960). In more recent work, Heather and colleagues labelled the two characteristics as one unitary construct, in an effort to operationalise IC and

to create an assessment tool for this clinically relevant component of problem drinking (Heather et al., 1993). In several studies, it has been proposed that the two symptom criteria of (1) loss of control and (2) inability to abstain actually represent features of the same underlying construct (Read et al., 2007). For example, Kahler and colleagues investigated the relation between these two constructs and found strong support for them being highly correlated constructs (Kahler et al., 1995). In another study, the psychometric properties of the Young Adult Alcohol Consequences Questionnaire was investigated in a sample of young adults ($n = 340$) (Read et al., 2007). The results showed that within the subscale of Impaired control, the items that targeted both these symptom domains were highly intercorrelated, and less correlated to items measuring other symptoms of AUD.

There is extensive evidence that IC predicts both problem drinking and the development of AUD. In experimental laboratory studies, nondependent young heavy episodic drinkers, with higher levels of IC underestimate their peak

breath alcohol concentration (BAC) and reach higher BAC levels at self-administration, compared to individuals with lower levels of IC (Vaughan et al., 2019; Wardell et al., 2018). Further, population-based studies in samples of adolescents and young adults have shown that IC is a moderator between perceived self-control and alcohol consumption, and a predictor of subjective sensitivity to alcohol, heavy episodic drinking and more severe alcohol related problems (Corbin et al., 2020; Leeman et al., 2012; Remmerswaal et al., 2019).

Studies in adult clinical populations have shown that individuals who experience loss of control are more severely dependent, have a higher risk for relapse after remission from AUD, and experience less favourable outcomes in treatment (Hasin et al., 2013; Heather & Dawe, 2005; Tuithof et al., 2014). Taken together, these findings emphasise the clinical relevance of measuring the degree of IC in patients with both problem drinking and AUD.

Instruments for the measurement of impaired control

Self-report assessment tools often incorporate single items with the aim of measuring IC as a symptom within the AUD spectrum (Leeman et al., 2014), e.g., the Alcohol Use Inventory (Bohn et al., 1995; Wennberg et al., 2014), the Alcohol Craving Scale (Jimenez et al., 2009), the Short Alcohol Dependence Data (SADD) (Raistrick et al., 1983) and the Alcohol Use Disorder Identification Test (AUDIT) (Saunders et al., 1993).

To our knowledge, the Impaired Control Scale (ICS) is the only instrument developed with the aim of specifically measuring an impairment in perceived loss of control over drinking . The ICS was constructed in three pre-defined parts. The first, "Attempted Control" (AC), aimed to measure to what degree an individual has tried to control alcohol consumption during the last six months. The second, "Failed Control" (FC), aimed to measure the difficulty for an individual to control alcohol

consumption. The third, "Perceived Control" (PC), addressed the perceived ability to control consumption in the future. A series of principal component analyses of all items combined suggested that AC was a distinctly separate scale, probably measuring another underlying construct than FC or PC in a clinical sample of individuals with AUD (Heather et al., 1993). In a two-component solution, FC and PC formed one distinct component and AC one component. Although FC and PC were strongly associated, Heather and colleagues decided to retain a distinction between FC and PC given evidence of a distinction between parts when examining a three-component solution.

In a subsequent study by the same scale developers, ICS was cross-validated in an independent English clinical sample ($n = 229$) (Heather et al., 1998). Similar to their previous study, correlation analyses showed that the first part (AC) was only marginally associated to FC and PC. Further, AC was only marginally associated to other measures of AUD and impaired control, while both FC and PC showed moderate to strong correlations to other measures of AUD and IC. Although the ICS was developed to measure one construct, previous studies have suggested that the first part of the scale (AC) does not measure IC, unlike part two (FC) and three (PC) (Heather et al., 1998; Wardell et al., 2018). Still, AC has been used in experimental studies investigating problem drinking, and in studies investigating patterns of problem drinking in non-clinical samples, together with FC and PC or as a single scale (Gunn et al., 2021). Further, although FC and PC have been shown to form a distinct construct, these parts have mainly been used separately in previous population-based studies and experimental studies when investigating IC and its predictive abilities (Corbin et al., 2020; Leeman et al., 2013; Leeman et al., 2009; Vaughan et al., 2019).

The current study

The aim of the present study was to evaluate the psychometric properties of a Swedish version of

the ICS in a sample of individuals fulfilling criteria of AUD. In the study, we used item response theory (IRT) methodology and confirmatory factor analysis to explore evidence of one-dimensionality for each part of the ICS (i.e., AC, FC, PC). Further, we explored convergent and divergent validity, and measurement invariance between genders, age groups and groups with different AUD severity. Finally, we investigated the sensitivity to change of the ICS parts, to assess the usefulness of the scales in clinical assessment and treatment evaluation.

Methods

Participants and procedure

The current study was conducted as a secondary data analysis including a clinical sample from a Swedish outpatient treatment facility for alcohol use disorders. The sample included 250 patients with a diagnosis of AUD according to the DSM-5 (APA, 2013) (see Table 1 for baseline characteristics of the sample).

Participants were recruited as part of a randomised controlled trial in an addiction outpatient clinic, with the aim of evaluating the effect of two psychological interventions during the period from August 2017 to December 2020 (ISRCTN: 14539251). Participants in the study were recruited from the study sites and via advertisements on Facebook, in which participation in a short-term treatment for alcohol problems was offered. Patients who had a diagnosis of substance use disorder (SUD) (with the exception of AUD and nicotine use disorder), any severe psychiatric disorder, e.g., severe major depression, suicidal behaviours, schizophrenia, or untreated bipolar disorder, or a severe physical risk related to continuous alcohol consumption, e.g., elevated liver enzymes or ongoing pregnancy, were not included in the study. All participants provided a written informed consent and then responded to self-report instruments as part of baseline measures.

The ICS was first translated from English to Swedish as part of a research project in Gothenburg (Berglund et al., 2008) by two researchers involved in the project (see Appendix 1). The Swedish version was thereafter back translated and revised by a bilingual person. In the current study, the Swedish version was again evaluated and compared to the English version by two of the authors with clinical expertise on assessment and treatment of AUD (SI & AH).

Measures

The impaired control scale. The ICS comprises 25 items divided into three subscales: Part 1, Attempted Control (AC); Part 2, Failed Control (FC); and Part 3, Perceived Control (PC). The responses are of Likert type, scored from 0 to 4. The ICS is interpreted by the sum of scores for all three parts, with a high value indicating a more severe degree of IC. Reverse coding was applied for items 9, 11, 12, 15, 19, 21, 22 and 25. If a responder has been abstinent during the given period, the instruction was to choose the alternative "not applicable" which is scored as 0. The internal consistency (Cronbach's alpha) was acceptable to good (AC = 0.78, FC = 0.82, PC = 0.86).

The alcohol use disorders identification test. The Alcohol Use Disorders Identification Test (AUDIT) (Saunders et al., 1993) is a validated 10-item instrument, which is used for screening of harmful alcohol use and alcohol dependence. The items address the level of alcohol consumption, drinking behaviours and alcohol-related problems in the past year. The responses are scored from 0 to 4. The internal consistency (Cronbach's alpha) of the total scores was 0.69.

The short alcohol dependence data. The Short Alcohol Dependence Data Questionnaire (SADD) (Raistrick et al., 1983) is a 15-item instrument which aims to measure current symptoms of alcohol dependence and related

Table 1. Demographics of participants at baseline.

Variable	Sample $n = 249$
Number of men (%)	52
Mean age (SD)	51.8 (11.1)
Mean AUD DSM-5 criteria (SD)	5.3 (2.0)
Mean weekly alcohol consumption 90 days before inclusion (SD)	23.9 (12.5)
Mean proportion of heavy drinking 90 days before inclusion[a] (SD)	0.44 (0.3)
Mean SADD total score (SD)	10.1 (4.8)
Mean MADRS-S-S total score (SD)	9.3 (6.8)
Mean GAD-7 total score (SD)	3.3 (3.7)
Mean ICS total score (SD)	44.9 (10.9)

Notes. AUD = alcohol use disorder; SADD = the Short Alcohol Dependence Data; MADRS-S = The Montgomery Asberg Depression Rating Scale; ICS = Impaired Control Scale.
[a]of days with drinking.

consequences. The internal consistency (Cronbach's alpha) of the total scores was 0.77.

The montgomery asberg depression rating scale.
The Montgomery Asberg Depression Rating Scale (MADRS-S-S) (Montgomery & Asberg, 1979) is a nine-item instrument which is validated and widely used to measure major depressive symptoms and the severity of major depression. The items cover the nine criteria of major depression, e.g., sadness, anhedonia, loss of appetite, sleeping problems and difficuly concentrating. The internal consistency (Cronbach's alpha) of the total scores was 0.87.

GAD-7. The GAD-7 (Spitzer et al., 2006) is a validated eight-item instrument for screening for general anxiety disorder (GAD) and assessing its severity, where the seven initial items reflect symptoms of GAD, and the eighth is used to rate the degree of disability due to the anxiety symptoms. The internal consistency (Cronbach's alpha) of the total scores was 0.89.

Data analysis

Missing item-level data were imputed using predictive mean matching, which has been found to extract a proper number of factors and low bias regarding factor loadings in situations with small samples and missing data (McNeish, 2017). One participant was excluded from the analyses because of missing data for the whole ICS, and other baseline measures which resulted in a total number of 249 in the sample.

To examine whether the items of AC, FC and PC reflected single constructs as has been suggested previously (Heather et al., 1993), we explored each part of the ICS using two different methods. First, we used a method commonly used within the IRT framework called principal component analysis of Rasch residuals (Chou & Wang, 2010). In this analysis, the standardised residuals from a polytomous Rasch model (using the Partial Credit Model) are explored in a principal component analysis (PCA). If the Rasch residuals extract a principal component, it indicates further dimensions beyond a first latent factor which implies that the assumption of one-dimensionality does not hold (Chou & Wang, 2010). To explore the evidence of additional dimensions, we compared the eigenvalue of the first principal component of the Rasch residuals with the eigenvalue of simulated random residuals. If the eigenvalue of the first principal component (after removing the impact of a latent factor) was not significantly larger than random noise, we considered the assumption of one-dimensionality to hold.

The second method to explore whether each part reflected a single construct was confirmatory factor analysis (CFA). In this analysis, we explored the goodness of fit according to a CFA for each part of the ICS. Given the five-point Likert scale of the responses, we used a maximum likelihood estimation with robust (Huber-White) standard errors (Rosseel, 2014). Goodness of fit indices explored were the robust (sample corrected) versions of Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Root Mean Square Error of Approximation (RMSEA) (Brosseau-Liard & Savalei, 2014; Brosseau-Liard et al., 2012). Different guidelines to interpret goodness of fit according to these

indices have been suggested. For example, Hu and Bentler (1999) suggested that RMSEA < 0.06 and CFI/TFI > 0.95 indicating a good fit. Others have suggested that RMSEA < 0.08 and CFI/TFI > 0.90 indicate acceptable fit (Hu & Bentler, 1999).

To examine the reliability of scale scores, we examined the internal consistency using Cronbach's alpha and ordinal alpha (Gadermann et al., 2012). We evaluated the convergent and divergent validity by, in a first step, examining the correlations between the total scores of the AC, FC and PC to the total scores of the AUDIT, the SADD, the MADRS and GAD-7. As mentioned, impaired control over alcohol consumption is strongly associated with AUD. Therefore, we hypothesised that the correlations between the ICS parts and AUDIT and between the ICS parts and SADD respectively, would be stronger compared to the correlations between the ICS parts and measures of depression and anxiety (MADRS and GAD-7). We used Pearson's correlations to explore the strength of associations, and Williams' test to evaluate differences between dependent correlations (Steiger, 1980).

In a next step, we performed a deepened analysis of convergent and divergent validity by examining correlations of the AC, FC and PC to specific items of the AUDIT and the SADD. We stated that specific items of the AUDIT and SADD would have stronger correlations to the ICS parts if the item was clearly addressing an aspect of IC than if not. Consequently, regarding AUDIT, we chose item 1, "How often do you drink alcohol?" (not specifically measuring IC) and item 4, "During the last year, how often weren't you able to stop drinking when you had started?" (specifically measuring IC) for further analyses. Regarding SADD, we chose item 4, "Do you drink in the morning, afternoon and in the evening?" (not specifically measuring IC), and item 8, "Do you know that it is impossible for you to stop drinking once you have started?" (specifically measuring IC). In these correlational analyses, we used Spearman's correlations to explore the strength of associations, and Williams' test to evaluate differences between dependent correlations (Steiger, 1980).

We explored the differential item functioning (DIF) from the same polytomous Rasch model that is described above. The DIF test explores whether a specific item has different statistical properties (i.e., difficulty of the item) between groups, while controlling for mean differences between groups (Eiji, 1999). In this study, we explored whether item function varied between men and women, between patients younger than 50 years and those aged 50 or above, and finally, between patients with severe AUD (i.e., six or more DSM-5 criteria of AUD) compared to those with less severe AUD (between two and five DSM-5 criteria). We used recommendations from Wu et al. (2016), suggesting a difference of 0.5 log odds in item difficulty to indicate problematic DIF.

We also explored sensitivity to change for each part of the ICS compared to AUDIT, SADD, MADRS and GAD-7 by calculating the within-group pre–post treatment effects (Cohen's d) with 95% confidence intervals based on 10,000 bootstrap standard errors. We hypothesised that the pre–post effects of the AC, FC and PC would be similar to the measures of AUD (i.e., AUDIT and SADD), and larger than other constructs not specifically targeted in the treatment, i.e., depression and anxiety (MADRS and GAD-7). Effect sizes were interpreted according to standard guidelines (Cohen, 1988). Attrition analyses comparing baseline characteristics of individuals lost to the 12-week follow-up (post treatment) with completers were conducted using t-tests (for continuous outcome) and chi-square tests (for categorical outcome).

All analyses were performed in the R software (R Core Team, 2021). Imputation was performed using the "mice" package, PCAs of Rasch-residuals using the "TAM" and "psych" packages, correlational analyses using the "stats" and "psych" packages, and DIF analyses using the "TAM" package.

Results

Missing data

For the ICS, 6% of the participants had missing data on one or several items. There was a total of 0.6% missing values in the complete data set, which was imputed using predictive mean matching.

Dimensionality

In a PCA of the standardised residuals for the AC part, the principal component showed an eigenvalue of 1.58. Simulated data (from 100 Rasch partial credit models using random data with an equal number of participants and items), showed that 95% of the eigenvalues were below 1.53. A one-factor CFA of the AC items showed that items loaded between 0.49 and 0.76 on the factor. The CFI and TFI showed evidence of a good fit (> 0.95) and the RMSEA (0.07) indicated an acceptable fit. See details on the CFA and fit indices in Table 2.

Regarding the FC part, the principal component showed an eigenvalue of 2.06, whereas the simulated random data showed that 95% of the eigenvalues were below 1.59, indicating some evidence of further dimensions underlying the responses. In the PCA, it was especially item number 12, "During the last six months, I have been able to stop drinking before becoming completely drunk", that showed a strong loading on the principal component. In the one-factor CFA, items loaded between 0.38 and 0.78. The CFI, TFI and RMSEA indicated poor fit (0.84, 0.79 and 0.12 respectively). When excluding item 12, the goodness of fit indices were improved (0.93, 0.90 and 0.08 respectively).

Finally, for the PC part, the principal component showed an eigenvalue of 1.74 (95% of eigenvalues of random data < 1.59). Like the FC part, the corresponding item (22) showed the strongest loading on the principal component. In the one-factor CFA, items loaded between 0.39 and 0.76. The CFI, TFI and RMSEA indicated relatively poor fit (0.91, 0.89 and 0.09 respectively). When excluding item 22, the goodness of fit indices improved (0.96, 0.94 and 0.07 respectively).

Reliability of the ICS

We found acceptable to good internal reliability of the AC scale scores (Cronbach's alpha = 0.78, ordinal alpha = 0.83) and good internal reliability for the FC and PC scores (Cronbach's alpha = 0.83 and 0.86 respectively, and ordinal alpha = 0.86 and 0.89 respectively).

Convergent and divergent validity

Table 3 presents the correlations between the total scores of AC, FC, PC, AUDIT, SADD, MADRS and GAD-7. In line with our first hypothesis on convergent and divergent validity, we found that the FC and PC correlated more strongly with SADD compared to the correlations with MADRS-S (i.e., depression, $p < 0.001$ and $p = 0.003$ respectively) and GAD-7 (i.e., anxiety, $p < 0.001$ both comparisons). Contrary to our hypothesis, AC correlated more strongly to GAD-7 compared to SADD ($p = 0.004$), and no difference in strength of association was found between AC and SADD compared to AC and MADRS-S ($p = 0.29$). The association between FC and AUDIT was larger than the associations between FC and MADRS-S and FC and GAD-7 ($p = 0.002$ and $p < 0.001$ respectively). The association between PC and AUDIT was larger than the association between PC and GAD-7 ($p = 0.015$), but not significantly different than the association between PC and MADSR-S ($p = 0.099$). Finally, no differences in strength of associations were found between AC and AUDIT compared to AC and MADRS-S ($p = 0.19$), AC and GAD-7 ($p = 0.23$).

Table 4 presents correlations between the total scores of AC, FC, PC, items 1 and 4 from AUDIT, and items 4 and 8 from SADD. In line with our second hypothesis on convergent and divergent validity, we found that the FC and PC correlated more strongly with AUDIT 4 compared to the correlation with AUDIT 1 ($p < 0.001$ both comparisons). Also, the FC and

Table 2. Factor loadings in three separate one-factor confirmatory factor analyses.

Items AC	Factor loadings	Items FC	Factor loadings	Items PC	Factor loadings
Item 1	0.68	Item 6	0.58	Item 16	0.71
Item 2	0.51	Item 7	0.60	Item 17	0.56
Item 3	0.49	Item 8	0.71	Item 18	0.76
Item 4	0.76	Item 9	0.38	Item 19	0.50
Item 5	0.53	Item 10	0.45	Item 20	0.39
		Item 11	0.60	Item 21	0.64
		Item 12	0.44	Item 22	0.46
		Item 13	0.78	Item 23	0.66
		Item 14	0.48	Item 24	0.46
		Item 15	0.52	Item 25	0.53
Fit indices		Fit indices		Fit indices	
R-CFI	0.98		0.84		0.91
R-TFI	0.97		0.79		0.89
R-RMSEA	0.07		0.12		0.09

Note. Factor loadings below 0.30 were omitted from the table. AC = Attempted Control; FC = Failed Control; PC = Perceived Control; R-CFI = Robust Comparative Fit Index; R-TFI = Robust Tucker-Lewis Index; R-RMSEA = Robust Root Mean Square Error of Approximation.

Table 3. Pearson's correlations between total scores of the AC, FC, PC, AUDIT, SADD, MADRS and GAD-7.

	FC	PC	AUDIT	SADD	MADRS	GAD
AC	0.15*	0.01	0.13*	0.15*	0.22***	0.22***
FC		0.47***	0.58***	0.60***	0.39***	0.27***
PC			0.37***	0.44***	0.25***	0.19**
AUDIT				0.63***	0.31***	0.24***
SADD					0.40***	0.36***
MADRS						0.71***

Note. AC = Attempted Control; FC = Failed Control; PC = Perceived Control; AUDIT = The Alcohol Use Disorders Identification Test; SADD = The Short Alcohol Dependence Data; MADRS = The Montgomery Asberg Depression Rating Scale.
*$p \leq 0.05$.
**$p \leq 0.01$.
***$p \leq 0.001$.

PC correlated more strongly with SADD 8 compared to the correlation with SADD 4 ($p < 0.001$ both comparisons. AC showed no significant association with any of the four items.

Measurement invariance

Regarding AC, we found no evidence of differential item functioning for any of the items between genders, age groups or severity of AUD. For FC we found some evidence of differential item functioning (but below our threshold for problematic difference) for item 10, "I started drinking at times when it would cause problems", between genders (log odds = 0.36), between age groups (log odds = 0.49) and between severe/less severe AUD (log odds = 0.48); and for item 14, "During the last six

Table 4. Spearman's correlations between total scores of the AC, FC and PC, and items 1 and 4 from AUDIT, and items 4 and 8 from SADD.

	FC	PC	AUDIT-1	AUDIT-4	SADD-4	SADD-8
AC	0.11	0.02	−0.11	0.09	0.04	0.03
FC		0.46***	0.00	0.55***	0.18**	0.56***
PC			−0.05	0.33***	0.07	0.37***
AUDIT-1				−0.05	−0.11	−0.10
AUDIT-4					0.08	0.49***

Notes. AC = Attempted Control; FC = Failed Control; PC = Perceived Control; AUDIT-1 = The Alcohol Use Disorders Identification Test – item 1; AUDIT-4 = The Alcohol Use Disorders Identification Test – item 4; SADD-4 = The Short Alcohol Dependence Data – item 4; SADD-8 = The Short Alcohol Dependence Data – item 8.
*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

months, I have found it difficult to resist drinking, even for a single day", between age groups (log odds = 0.47). For PC, only item 24, "I would find it difficult to resist drinking, even for a single day", showed some evidence of different difficulty between age groups (log odds = 0.40). In conclusion, assuming the same level of failed control, men, participants below the age of 50, and those with severe AUD scored higher than women, older participants, and those with less severe AUD on item 10. Regarding items 14 and 24, older participants scored higher than younger, assuming the same level of overall failed control/perceived control.

Sensitivity to change

FC was the measure that had the largest change between the baseline and the 12-week assessment, interpreted as close to a large effect size (see Table 5). AC, SADD and AUDIT showed moderate changes. PC showed a small change, and MADRS and GAD-7 marginal changes. Because of loss to follow-up, the sensitivity to change analyses was explored in a subsample ($n = 217$) of the whole study sample ($N = 249$). When comparing those lost to follow-up ($n = 32$) to completers, we found no statistically significant baseline differences regarding gender ($p = 0.65$), age ($p = 0.17$), number of AUD criteria ($p = 0.96$), weekly alcohol consumption ($p = 0.23$), or ratings on the SADD ($p = 0.76$), AUDIT ($p = 0.55$), GAD-7 (p = 0.61), MADRS ($p = 0.35$), or any of the ICS parts (p-values ranging from 0.34 to 0.81).

Discussion

In the present study we aimed to psychometrically evaluate a Swedish version of the ICS. We found that the FC part was the most valid measure of the underlying construct of IC. This part was also highly sensitive to target treatment effect, which makes it useful for treatment evaluation in clinical settings and in research studies. These findings are in line with the theoretical underpinnings of IC, as failed control should measure the symptom criteria of IC involved in the AUD spectrum (Grant et al., 2015; Heather et al., 1993).

Dimensionality

An important aspect of a scale using the sum of the scores for interpretation, is that the items reflect a single latent variable (McNeish & Wolf, 2020). In this study, we found reasonable evidence of one-dimensionality for the AC scale. The FC and the PC showed reasonable fit to a one-dimension model first after excluding item 12 in the FC part, "During the last six months, I have been able to stop drinking before becoming completely drunk", and item 22 in the PC part, "I would be able to stop drinking before becoming completely drunk". One possible

Table 5. Pre–post effect sizes between baseline and 12-week assessment, including groups treated with BSCT and MET ($n = 217$).

Measure	Pre M (SD)	Post M (SD)	t-value[a]	Cohen's d pre–post [95% CI]
AC	9.6 (3.3)	11.8 (2.9)	−9.45***	−0.68 [−0.85, −0.54]
FC	20.5 (6.2)	15.6 (6.8)	13.07***	0.79 [0.65, 0.95]
PC	14.4 (6.1)	12.2 (6.1)	5.36***	0.36 [0.22, 0.50]
AUDIT	19.0 (5.8)	15.8 (5.9)	11.31***	0.55 [0.45, 0.67]
SADD	10.1 (4.8)	7.3 (4.5)	10.99***	0.58 [0.47, 0.69]
MADRS	9.2 (6.8)	8.1 (6.8)	3.06**	0.16 [0.06, 0.26]
GAD-7	3.4 (3.8)	2.9 (3.6)	2.81**	0.15 [0.05, 0.24]

Note. BSCT = Behavioral Self-Control Training; MET = Motivational Enhancement Therapy; AC = Attempted Control; FC = Failed Control; PC = Perceived Control; AUDIT = The Alcohol Use Disorders Identification Test; SADD = The Short Alcohol Dependence Data; MADRS = The Montgomery Asberg Depression Rating Scale.
[a]t-value from a paired t-test.
*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

reason for multidimensionality may be that these items measure severity of dependence to a higher degree than impaired control. From a clinical perspective, individuals with AUD experience the ability to control consumption as highly varying, and even individuals with more severe AUD acknowledge the ability to control consumption in some situations (Grant et al., 2015). Still, the individuals who are not able to stop drinking on any occasion are likely to be those who have a more severely developed AUD, i.e., the severity of AUD is likely to influence the experience of IC in this sample.

Convergent and divergent validity

The analyses on convergent and divergent validity produced interesting results. First, AC had weak correlations to the measures of AUD or IC (FC and PC), which is in line with earlier studies performed by Heather and colleagues. In the English version of ICS, Heather et al. (1993) found it relevant to keep the AC, as it would capture what they presumed to be a clinically meaningful aspect of IC. The results from the present study, including a modest sample of treatment seeking individuals with AUD, indicate that AC may be the least useful of the three subscales for the measurement of individuals with AUD,

as it is not related to IC as a construct. Importantly, AC has been found to be a relevant aspect of IC, e.g., as a predictor and mediator of higher BAC levels and stronger subjective responses to alcohol involving a nondependent sample (Vaughan et al., 2019). We therefore do not suggest excluding the AC part of the Swedish ICS. Replicating studies and further studies on the validation of the Swedish ICS in nondependent samples are therefore warranted.

Second, FC showed the strongest associations to other measures of AUD as well as specific items of impaired control from the AUDIT and SADD. The associations between FC, SADD and AUDIT suggest that FC is clearly associated to the construct of AUD. Further, clear differences regarding correlations between specific items speaks of divergent validity for the FC. Finally, PC had similar results on convergent validity, but not as strong divergent validity as it was equally associated to depressive symptoms as measured by MADRS as the one of AUD.

Measurement invariance

The analyses of measurement invariance pointed out three items which had some evidence of a differential item functioning, in FC and PC. In FC the first was item 10, "I started drinking at times when it would cause me

problems", where the results showed that men and women, and younger and older responders scored differently, despite assuming the same degree of IC. This item includes examples, e.g., having problems at work or with the police which may guide responders towards the kind of difficulties that may be expected in the answer. On a group level, younger individuals and men (regardless of level of IC) are more likely to be involved in norm-breaking behaviours, such as allowing work to be affected or be involved in accidents or violent behaviours which involve the police (Estrada & Nilsson, 2012; Richardson & Budd, 2003). Thus, younger male individuals are more likely to endorse items concerning these negative consequences.

The second and third items with some different functioning were item 14 in FC and the corresponding item 24 in PC: "During the last six months, I have found it difficult to resist drinking, even for a single day/would find it difficult to resist drinking even for a single day". The differences in answers showed that older individuals were more prone to score highly on the item, although theoretically having the same level of IC. Given that both younger and older individuals score the same mean level of IC in the measure of invariance, these differences may be explained by a confounding variable, which is time exposed to the drug. This is not surprising in the light of known epidemiological research on AUD, showing that older individuals have more difficulties abstaining due to a longer exposure to the drug (Adamson et al., 2009; Grant et al., 2015). This may contribute to the endorsement of an item reflecting a more severe loss of control, compared to others.

Sensitivity to change

When we compared the different measures of AUD regarding sensitivity to change, the FC showed the largest change post treatment (12 weeks after inclusion). The PC showed much smaller decreases. This is reasonable given that FC is designed to measure degree of

impaired control in the near future, which is the main target in treatment. This is compared to PC, which is not related to the actual ability to control, but may be a secondary consequence in of being engaged in treatment and would in the best case improve individual self-efficacy of change. Perceived control may also be influenced by the individual's general overall perception of self-efficacy or self-confidence, which may be a more stable trait than FC. The AC also clearly changed during treatment. This is also intuitive, given that most individuals have a clear intention of increasing their attempt to control alcohol consumption when initiating treatment.

Significance of the study

The current study contributes to the validation of a Swedish version of the ICS, which has been identified as a core symptom of AUD, but at the same time an under-addressed aspect of AUD (Leeman et al., 2014; Leeman et al., 2012). The original ICS was constructed to measure IC as a target in treatment, and to measure outcomes of treatment interventions. The Swedish ICS has the potential to be used in both these respects, and FC may be the most valid part for these purposes.

Limitations

There are several limitations of this study which need to be mentioned. First, a more rigorous method to validate the Swedish version of the ICS would have included an exploratory factor analysis on a random subsample of the total sample, and a CFA on the other subsample. However, such an approach was not considered feasible given the sample size of the current study. Second, the generalisability of the results; given that the study sample was recruited in a specialised addiction clinic, in which the majority of the participants were seeking care for the first time. In addition, the sample was recruited in the context of a randomised controlled study, which may have increased selection

bias in the sample. On the other hand, the choice of sample has advantages. From an epidemiological perspective the sample is representative of a broad spectrum of individuals with AUD in the general population, with mild to moderate AUD, and with a low degree of psychiatric comorbidities (Andreasson et al., 2013; Grant et al., 2015). Still, the Swedish version of the ICS would benefit from validation in a nondependent sample and among problem drinkers to further investigate its psychometric properties and the relation between the three parts. Further, analyses on convergent/divergent validity were based on correlations between the ICS and specific items from other scales assumed to measure IC. A validated measure of IC, such as a subscale from another questionnaire measuring IC, may have provided additional evidence of convergent and divergent validity. Lastly, the addition of measures of, e.g., impulsivity and craving, could have contributed to the analyses on convergent and divergent validity of the ICS.

Availability of data and material

Data and material are available upon request.

Declaration of conflicting interests

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Appendix I

The Impaired Control Scale

Part 1

1. During the last six months, I have tried to limit the amount I drank.
2. During the last six months, I have tried to resist the opportunity to start drinking.
3. During the last six months, I have tried to slow down my drinking.
4. During the last six months, I have tried to cut down on my drinking (i.e., drink less).
5. During the last six months, I have tried to stop drinking for a period of time.

Part 2

6. During the last six months, I have found it difficult to limit the amount I drank.
7. During the last six months, I have started drinking even after deciding not to.
8. During the last six months, even when I intended having only one or two drinks, I have ended up having many more.
9. During the last six months, I have been able to cut down my drinking (i.e., drink less) when I wanted to.
10. During the last six months, I have started drinking at times when I knew it would cause me problems (e.g., problems at work, with family/friends or with the police, etc.).
11. During the last six months, I have been able to stop drinking easily after one or two drinks.

12. During the last six months, I have been able to stop drinking before becoming completely drunk.
13. During the last six months, I have had an irresistible urge to continue drinking once I started.
14. During the last six months, I have found it difficult to resist drinking, even for a single day.
15. During the last six months, I have been able to slow down my drinking when I wanted to.

Part 3

16. I would have difficulty limiting the amount I drink.
17. I would start to drink, even if I'd decided not to.
18. Even if I intended having only one or two drinks, I would end up having many more.
19. I could cut down my drinking (i.e., drink less) if I wanted to.
20. I would start drinking at times when I knew it would cause me problems (e.g., problems at work, with family/friends or with the police, etc.).
21. I could stop drinking easily after one or two drinks.
22. I would be able to stop drinking before becoming completely drunk.
23. I would have an irresistible urge to continue drinking once I started.
24. I would find it difficult to resist drinking, even for a single day.
25. I could slow down my drinking if I wanted to.