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# Assessing negative symptoms in schizophrenia: Validity of the clinical assessment interview for negative symptoms in Singapore

Gurpreet Rekhi [a,*], Mei San Ang [a], Caryn Kai Yan Yuen [a], Wai Yee Ng [a], Jimmy Lee [a,b,c]

[a] Research Division, Institute of Mental Health, Singapore, Singapore
[b] North Region & Department of Psychosis, Institute of Mental Health, Singapore
[c] Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore

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ABSTRACT

This study aimed to examine the validity of the Clinical Assessment Interview for Negative Symptoms (CAINS) in Singapore. 274 participants with schizophrenia were assessed on the CAINS, Scale for the Assessment of Negative Symptoms (SANS), Positive and Negative Syndrome Scale (PANSS), Calgary Depression Scale for Schizophrenia (CDSS), Social and Occupational Functioning Assessment Scale (SOFAS) and the Simpson-Angus Extrapyramidal Side Effects Scale (SES). Factor analyses were conducted and Cronbach's coefficient alpha was calculated. Spearman's correlation coefficient was used to assess correlations. The 2-factor model of the CAINS failed to fit our data. Exploratory factor analysis of a randomly selected split-half of the sample yielded four factors: motivation-pleasure (MAP) social, MAP vocational, MAP recreational and expression (EXP), accounting for 73.94% of the total variance. Confirmatory factor analysis on the remaining sample supported this factor structure. Cronbach's alpha for the CAINS was 0.770. Significant correlations were observed between the CAINS total and the SANS total and PANSS negative subscale scores. Good divergent validity was shown by insignificant correlations with PANSS positive subscale score and CDSS total score. The MAP social and recreational factor scores had moderate correlations with the SANS anhedonia-asociality subscale scores, whereas the MAP vocational factor had the highest correlation with the avolition-apathy subscale of the SANS. EXP factor score correlated strongly with the SANS affective flattening and alogia subscales scores. In conclusion, the CAINS has good psychometric properties and can be used by clinicians to assess negative symptoms in individuals with schizophrenia in the local population.



## 1. Introduction

Negative symptoms are described as a distinct entity of the schizophrenic psychopathology, with a different prognosis than positive or disorganized symptoms (Blanchard and Cohen, 2006; Peralta and Cuesta, 2001). Historically, they have been described as the "core" symptoms of schizophrenia and characterized by loss or deficits (Bleuler, 1969; Kraepelin and Robertson, 1919). Negative symptoms have been reported to be associated with impairments in functioning in patients with schizophrenia (Fervaha et al., 2014; Lysaker and Davis, 2004; Milev et al., 2005; Rabinowitz et al., 2012), yet were largely ignored in the past because of the lack of available treatment options. Persistent and clinically significant negative symptoms represent an unmet therapeutic need for large numbers of patients with schizophrenia (Kirkpatrick et al., 2006). Current pharmacological treatment for negative symptoms showed only small or modest effect sizes and inconsistent results have been found (Buckley and Stahl, 2007; Moller and Czobor, 2015; Murphy et al., 2006; Remington et al., 2016).

Clinical trials exploring treatment options for negative symptoms require suitable rating scales for their assessment, however the commonly used rating scales like the scale for Assessment of Negative Symptoms (SANS) (Andreasen, 1982), the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987), and the Negative Symptom Assessment scale (NSA-16) (Alphs et al., 1989) were reported to have certain limitations (Kirkpatrick et al., 2006). The Clinical Assessment Interview for Negative Symptoms (CAINS) was developed to overcome these limitations (Forbes et al., 2010). The CAINS has been reported to have strong inter-rater and test-retest reliability, internal-consistency, and convergent and discriminant validity when used in individuals with schizophrenia (Horan et al., 2011; Kring et al., 2013; Strauss and Gold, 2016), as well as schizophrenia spectrum disorders (Blanchard et al., 2017; Xie et al., 2018). Factor analysis of the CAINS showed a 2-factor structure, a motivation-pleasure (MAP) factor consisting of 9 items (items 1–9) and an expression (EXP) factor consisting of the remaining 4 items (Horan et al., 2011; Kring et al., 2013).

* Corresponding author at: Research Division, Institute of Mental Health, 10 Buangkok View, 539747, Singapore.
*E-mail address:* gurpreet_rekhi@imh.com.sg (G. Rekhi).

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The CAINS has various advantages over the existing negative symptom rating scales. It assesses internal experiences that include the intensity of motivation and interest to engage in activities in social, vocational and recreational areas in addition to actual behavior manifested. Most importantly, it differentiates between anticipatory and consummatory anhedonia. It's postulated that people with schizophrenia have disabilities in forecasting pleasurable experience while their ability to experience pleasure at the moment is intact (Chan et al., 2010; Gard et al., 2007). Additionally, CAINS has structured probes and questions for interview and standardized videos and comprehensive manuals are available for training of interviewers on the CAINS (Barch, 2013).

Various versions of the CAINS have been developed and validated in different populations: German (Engel et al., 2014), Spanish (Valiente-Gomez et al., 2015), Chinese (Chan et al., 2015) and Korean (Jung et al., 2016). All these studies supported the 2-factor structure of the CAINS; however, the Chinese version of the CAINS was reported to have different items in the two factors: items 2, 3, 4, 6, 7, 8 and 9 in the MAP factor, and items 1, 5, 10, 11, 12 and 13 in the EXP factor. The Korean version of the CAINS was also reported to have a 2-factor structure, however, the reported fit stats of the model were not in the acceptable range: TLI = 0.806, CFI = 0.863, RMSEA = 0.140.

Given the various advantages of the CAINS in assessing negative symptoms, it is important to validate it in the local population of Singapore for use in future, both in the clinical and research settings. This study aims to assess the validity of the CAINS when used to assess negative symptoms in individuals with schizophrenia in Singapore. We assessed the internal consistency, convergent and divergent validity, and dimensional structure of the CAINS. We hypothesized that the CAINS would be valid to use in the local population with schizophrenia.

## 2. Materials and methods

### 2.1. Setting and study participants

Patients with a diagnosis of schizophrenia, with ages between 21 and 65, and able to speak English were recruited as study participants, from the outpatient clinics at the Institute of Mental Health (IMH), Singapore. Participants were excluded if they had (i) a current alcohol or substance use disorder, (ii) mental retardation (IQ < 70), or (iii) a history of head injury or neurological disorder. The Structured clinical Interview for DSM-IV (SCID I) (First et al., 2002) was used to ascertain the diagnosis of schizophrenia. A total of 277 participants were recruited for the study from August 2014 to December 2017. Three out of the 277 participants withdrew from the study, and were not assessed on the CAINS. Therefore, for this study, the total sample reported is 274.

Ethics approval for this study was provided by the National Healthcare Group's Domain Specific Review Board. Written informed consent was obtained from all the participants.

### 2.2. Study assessments

The CAINS is used to measure the current level of severity of negative symptoms in patients with schizophrenia or schizoaffective disorder. It has 13 items divided into two subscales, a 9-item MAP subscale and a 4-item EXP subscale. Motivation items measure individuals' behavior and internal experience in social, occupational, and recreational activities. The expression items assess affective flattening in terms of facial expression, gestures and vocal intonation, as well as quantity of speech. Each item is rated on a 5-point scale, with anchor points ranging from the symptoms being absent (0) to severe (4). The original English version of the CAINS was used in this study.

Psychopathology was assessed on the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987).The PANSS has 30 items rated on a Likert scale from 1 to 7, assessing the positive (7 items), negative (7 items) and general psychopathology (16 items) domains of schizophrenia. A higher rating on PANSS indicates higher level of psychopathology. The negative symptom factor scores of PANSS, diminished emotional expression (DEE) consisting of items N1, N3, N6, G7 and G13 and social amotivation (SA) consisting of items N2, N4 and G16, were computed (Lim et al., 2016). Further assessment was done on the Scale for the Assessment of Negative Symptoms (SANS) which measures negative symptoms on a 25 item, 6-point scale. Items are categorized into five domains of negative symptoms: affective blunting, alogia, avolition/apathy, anhedonia/asociality, and attention (Andreasen, 1982).

Severity of depressive symptoms was assessed using the Calgary Depression Scale for Schizophrenia (CDSS) which has 9 items rated from 0 (absent) to 3 (severe) (Addington et al., 1990). The Social and Occupational Functioning Assessment Scale (SOFAS) was used to assess social and occupational or role functioning from excellent (100) to grossly impaired (0) (Goldman et al., 1992). Rating on the SOFAS is based exclusively on the individual's level of social and occupational functioning and is not directly influenced by the severity of the individual's psychological symptoms. Extrapyramidal side effects of antipsychotics were measured on the Simpson-Angus EPS Scale (SES). It has 10 items rated on a five-point scale from 0 to 4 (Simpson and Angus, 1970).

The assessments were done by three raters: one research clinician, one master level research psychologist and one bachelor level research psychologist. The raters had a minimum of 2 years' experience in administering rating scales and rating symptoms on individuals with schizophrenia, and underwent training on the administration and scoring for the CAINS and other measures. The training included didactic teaching on symptoms of schizophrenia, review of the manuals and rating instructions for all the rating scales, clinical interviews and joint assessment of video-recorded patient interviews. The raters obtained an intra-class correlation coefficient (ICC) of above 0.80 for ratings on the CAINS, PANSS and SANS. Supervision was provided by a research clinician, and bi-monthly case discussion and rater meetings were conducted to ensure adequate agreement in rating.

### 2.3. Statistical analyses

Descriptive statistics were used for socio-demographic data and to calculate means of scores on rating scales. T-test was used to compare total CAINS scores between males vs. females and those living with family vs. those not living with family. A confirmatory factor analysis (CFA) was done to assess if the 2-factor structure reported for the CAINS could fit our data and goodness of fit indices were evaluated. As the fit indices on the CFA were not acceptable, the sample was randomly split into two datasets of approximately equal size using SPSS. Exploratory factor analysis (EFA) using weighted least square mean and variance (WLSMV) estimation and oblique rotation was conducted on the first split-half sample (SET A: $n = 133$). The number of factors was determined by the goodness of fit indices like Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Standardized Root Mean Square Residual (SRMR). Only items with loading >0.32 were included in a factor (Tabachnick and Fidell, 2001). A confirmatory factor analyses (CFA) was conducted on the second split-half sample (SET B: $n = 141$) to confirm the model identified from the EFA. This CFA model fit was evaluated with RMSEA, CFI, TLI, and Weighted root mean residual (WRMR).

Factor scores were evaluated using summation method. Cronbach's coefficient alpha were calculated to assess internal consistency of the CAINS and its factors; and item to total correlations were also calculated (Cronbach, 1951). Spearman's correlation coefficient was used to assess the correlations between the CAINS total score and age and duration of psychosis, scores on the PANSS negative and positive subscales and its negative symptom factors: DEE and SA, SANS and its subscales, CDSS, SOFAS and SES; as well as between the CAINS factor scores and these variables. Factor analyses were conducted using M-plus version 7.4, all other statistical analyses were performed using IBM SPSS Statistics 23.

## 3. Results

### 3.1. Socio-demographic characteristics of the study sample

The socio-demographic characteristics of the study participants are shown in Table 1. The sample consisted of almost equal number of males ($n = 152$, 55.5%) and females ($n = 122$, 44.5%). Most of the participants were of Chinese ethnicity ($n = 231$, 84.3%) and living with their families (which included parents, spouse/partner, siblings and/or other relatives) ($n = 219$, 79.9%). Remaining 55 (20.1%) of the participants either lived alone, with friends/housemates or in rehabilitation homes. Sixteen (11.8%) out of the 136 employed participants had sheltered employment.

### 3.2. Clinical characteristics of the study sample

Table 2 shows the clinical characteristics of the study participants. The CAINS total ranged from 0 to 37. The mean PANSS DEE score was 11.01 (SD = 4.05), whereas the mean PANSS SA score was 6.64 (SD = 2.67). Nine subjects had a current depressive episode and 1 had current dysthymic disorder. None had mania at the time of assessment. Almost half of the study participants ($n = 122$, 44.5%) were prescribed with atypical antipsychotics only, whereas 58 (21.2%) of them were prescribed with typical antipsychotics only. Around one-third of the participants ($n = 85$, 31.0%) were taking both types and 4 (1.5%) of them were not on antipsychotics currently.

### 3.3. Association of CAINS scores with age, gender, duration of psychosis and living arrangement

The CAINS score did not differ significantly between males and females (M = 17.41, SD = 7.88 vs. M = 15.71, SD = 7.73; t (272) = 1.791, $p = 0.074$), and was not correlated to either age (spearman's rho = 0.040, $p = 0.507$) or duration of psychosis (spearman's rho = 0.086, $p = 0.157$). Those living with family did not have significantly different CAINS total score as compared to those not living with family (M = 16.44, SD = 7.95 vs. M = 17.53, SD = 7.42; t (272) = 0.920, $p = 0.359$).

### 3.4. CAINS factor structure

CFA using the previously reported 2-factor model yielded the following fit statistics: RMSEA = 0.133, CFI = 0.869, TLI = 0.840, WRMR = 1.750, indicating poor model fit (Hooper et al., 2008). The EFA of the 13 items in the CAINS using SET A yielded four factors, which accounted for 73.94% of the total variance. Table 3 shows the loadings of the CAINS items on these factors: factor 1 (MAP social), factor 2 (MAP vocational), factor 3 (MAP recreational) and factor 4 (EXP). MAP social factor was weakly correlated to MAP recreational factor ($r = 0.389$, $p < 0.05$), whereas MAP vocational and EXP factors were not significantly correlated to any of the other factors. This 4-factor model showed a reasonably good fit based on EFA fit statistics, with RMSEA = 0.064, CFI = 0.985, TLI = 0.963 and SRMR = 0.040. CFA on SET B confirmed the 4-factor model derived from the EFA, with acceptable fit stats: RMSEA = 0.078, CFI =0.955, TLI = 0.940 and WRMR = 0.793.

**Table 1**
Socio-demographic characteristics of the study participants.

| | *N* | % |
|---|---|---|
| Gender | | |
| Male | 152 | 55.5 |
| Female | 122 | 44.5 |
| Ethnicity | | |
| Chinese | 231 | 84.3 |
| Indians | 20 | 7.3 |
| Malay | 22 | 8.0 |
| Others | 1 | 0.4 |
| Marital status | | |
| Married | 35 | 12.8 |
| Unmarried/separated/divorced/widowed | 239 | 87.2 |
| Living arrangement | | |
| With family | 219 | 79.9 |
| Not with family | 55 | 20.1 |
| Employment status | | |
| Employed | 139 | 50.7 |
| Unemployed | 124 | 45.3 |
| Student/homemaker | 11 | 4.0 |
| | Mean | S.D. |
| Age (years) | 40.39 | 10.15 |

**Table 2**
Clinical characteristics of the study participants.

| | Mean | S.D. |
|---|---|---|
| Duration of psychosis (years) | 17.31 | 9.64 |
| Daily dosage of antipsychotics (CPZ equivalents, mg/day) | 464.37 | 410.77 |
| CAINS | | |
| Motivation-Pleasure subscale | 11.94 | 6.16 |
| Expression subscale | 4.72 | 3.74 |
| Total | 16.66 | 7.85 |
| PANSS | | |
| Positive | 12.95 | 4.92 |
| Negative | 17.72 | 5.58 |
| General psychopathology | 27.44 | 5.96 |
| Total | 58.11 | 12.88 |
| SANS | | |
| Affective flattening | 7.82 | 6.60 |
| Alogia | 3.92 | 2.92 |
| Avolition-apathy | 4.99 | 3.15 |
| Anhedonia-asociality | 8.15 | 3.90 |
| Attention | 2.27 | 1.84 |
| Total | 27.15 | 12.65 |
| CDSS total | 2.84 | 3.18 |
| SOFAS | 55.57 | 11.19 |
| SES total | 1.96 | 2.71 |

Abbreviations: CPZ, Chlorpromazine; CAINS, Clinical Assessment for Negative Symptoms; PANSS, Positive and Negative Syndrome Scale; SANS, Scale for Assessment of Negative Symptoms; CDSS, Calgary Depression Scale for Schizophrenia; SOFAS, Social and Occupational Functioning Assessment Scale; SES, Simpson-Angus EPS Scale.

### 3.5. Internal consistency reliability of the CAINS and its factors

Cronbach's alpha for the CAINS was 0.770 which is good; and item to total correlation ranged from 0.329 to 0.463 (see Table 4). Cronbach's alpha for factors 1, 2, 3 and 4 were 0.719, 0.724, 0.735 and 0.829, respectively.

### 3.6. Convergent and divergent validity of the CAINS

The CAINS total and its factor scores were significantly correlated with the SANS total scores. Out of the 4 CAINS factors, the MAP social and MAP recreational factor scores had moderate correlations with the SANS anhedonia-asociality subscale (Spearman's rho = 0.583 and 0.434, respectively, both $p < 0.001$). The MAP vocational factor had the highest correlation with the avolition-apathy subscale of SANS (Spearman's rho = 0.548, $p < 0.001$) whereas CAINS EXP factor score correlated strongly with scores on the SANS affective flattening and alogia subscales (Spearman's rho = 0.914 and 0.668, respectively, both $p < 0.001$) (see Table 5).

The CAINS total and EXP factor scores were found to have strong correlations with the PANSS negative subscale total score. Further, the CAINS total was significantly correlated with the PANSS DEE and SA factor scores (Spearman's rho = 0.638 and 0.580, respectively, both $p < 0.001$). The three CAINS MAP factors (social, vocational and recreational) had weak correlations with the PANSS DEE factor scores (Spearman's rho = 0.317, 0.223 and 0.167 respectively, all $p < 0.001$), but the EXP factor had strong correlations to the DEE factor scores

**Table 3**
Factor loadings of the CAINS items from exploratory factor analysis.

| CAINS Items | Factor 1: MAP social | Factor 2: MAP vocational | Factor 3: MAP recreational | Factor 4: EXP |
|---|---|---|---|---|
| Item 1: Social, family relationships | 0.626 | | | |
| Item 2: Social, friendships | 0.359 | | | |
| Item 3: Social, past-week pleasure | 0.834 | | | |
| Item 4: Social, expected pleasure | 0.766 | | | |
| Item 5: Vocational, motivation | | 1.781 | | |
| Item 6: Vocational, expected pleasure | | 0.333 | | |
| Item 7: Recreation, motivation | | | 0.815 | |
| Item 8: Recreation, past-week pleasure | | | 0.853 | |
| Item 9: Recreation, expected pleasure | | | 0.656 | |
| Item 10: Expression, facial | | | | 0.850 |
| Item 11: Expression, vocal prosody | | | | 0.886 |
| Item 12: Expression, gestures | | | | 0.873 |
| Item 13: Expression, speech | | | | 0.599 |
| Variance accounted for (%) | 20.71 | 32.62 | 10.82 | 9.79 |

Abbreviations: CAINS, Clinical Assessment for Negative Symptoms; MAP, Motivation-Pleasure; EXP, Expression.

(Spearman's rho = 0.834, p < 0.001). PANSS SA was moderately correlated with the MAP social factor (Spearman's rho = 0.533, p ⟨0001) whereas the remaining two CAINS MAP factor scores and EXP score were weakly correlated with PANSS SA (Spearman's rho = 0.302, 0.300 & 0.341 respectively all $p < 0.001$).

Neither the CAINS total nor any of its factor scores was found to be correlated with the PANSS positive subscale score. CAINS total score did not correlate with the CDSS total score, and the MAP social and MAP recreational factor scores correlated very weakly with the CDSS total score. There were no significant correlations between CAINS total or its factor scores and the PANSS depression item. CAINS total and EXP factor showed weak correlations with the SES total score (see Table 5).

### 3.7. Association between CAINS scores and functioning

CAINS total score was strongly and inversely correlated with functioning measured by the SOFAS (Spearman's rho = −0.631, $p < 0.001$). Among the CAINS factors, MAP social and vocational factors had moderate negative correlations with functioning (Spearman rho = −0.429 and −0.578, respectively, both $p < 0.001$), whereas MAP recreational and EXP factors were weakly and negatively correlated with functioning (Spearman's rho = −0.320 and −0.344, respectively, all $p < 0.001$).

## 4. Discussion

This study sought to examine the validity of the CAINS when used to assess negative symptoms in individuals with schizophrenia in the local population in Singapore. The results of this study suggested that the CAINS had high internal reliability, good convergent and divergent validity, and a 4-factor structure when used in our local population with schizophrenia.

The mean CAINS score for the participants in our sample was lower in comparison to that reported in previous literature on the CAINS (Chan et al., 2015; Engel et al., 2014; Jung et al., 2016; Kring et al., 2013; Valiente-Gomez et al., 2015), which could be due to various factors. Our study sample comprised of only outpatients with schizophrenia, whereas some of the previous studies on the CAINS included acute or hospitalized individuals as their study participants as well (Engel et al., 2014; Jung et al., 2016; Valiente-Gomez et al., 2015). Cultural differences in appraisal of emotional situations could be another reason for this finding. Appraisal of emotional situations and expression of emotions are influenced by socio-cultural practices and patterns (Lim, 2016; Mesquita and Walker, 2003). Moreover, it has been reported that individuals from different cultures might rate the intensity of emotional expressions differently (Matsumoto and Ekman, 1989).

This study indicates that the 13 CAINS items load onto four separate components: MAP social, MAP vocational, MAP recreational and EXP. These results are in contrast to the 2-factor structure of the CAINS reported so far (Chan et al., 2015; Engel et al., 2014; Jung et al., 2016; Kring et al., 2013; Valiente-Gomez et al., 2015). The structure of negative symptoms and the relationships between its domains is not very clear. Before the development of the CAINS, factor analytic studies examining the structure of negative symptoms using the SANS reported that negative symptoms are multi-dimensional, with 2, 3 or 5 factors (Blanchard and Cohen, 2006; Kirkpatrick et al., 2006). Diminished expression (DE) and a combined anhedonia-asociality (AA) domain were considered the two most reliable of these domains (Blanchard and Cohen, 2006; Peralta and Cuesta, 1999). However, it has been argued that DE items may load onto one factor since they are rated based on observation during an interview, whereas the AA items cohere

**Table 4**
Internal consistency reliability statistics of the CAINS.

| CAINS Items | Mean | S.D. | Item-total correlation | Cronbach's alpha if item deleted |
|---|---|---|---|---|
| Item 1: Social, family relationships | 0.92 | 0.88 | 0.431 | 0.754 |
| Item 2: Social, friendship | 1.41 | 0.961 | 0.411 | 0.755 |
| Item 3: Social, past-week pleasure | 1.14 | 1.287 | 0.407 | 0.754 |
| Item 4: Social, expected pleasure | 1.30 | 1.389 | 0.463 | 0.748 |
| Item 5: Vocational, motivation | 1.68 | 1.246 | 0.329 | 0.763 |
| Item 6: Vocational, expected pleasure | 2.13 | 1.623 | 0.368 | 0.763 |
| Item 7: Recreation, motivation | 1.31 | 0.984 | 0.448 | 0.752 |
| Item 8: Recreation, past-week pleasure | 1.45 | 0.987 | 0.367 | 0.758 |
| Item 9: Recreation, expected pleasure | 0.61 | 1.054 | 0.379 | 0.757 |
| Item 10: Expression, facial | 1.43 | 1.163 | 0.459 | 0.749 |
| Item 11: Expression, vocal prosody | 0.93 | 1.064 | 0.380 | 0.757 |
| Item 12: Expression, gestures | 1.07 | 1.178 | 0.339 | 0.761 |
| Item 13: Expression, speech | 1.28 | 1.189 | 0.433 | 0.752 |

Abbreviations: CAINS, Clinical Assessment for Negative Symptoms.

**Table 5**
Convergent and divergent validity of the CAINS.

| | CAINS total | | MAP social | | MAP vocational | | MAP recreational | | EXP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Spearman's rho | p | Spearman's rho | p | Spearman's rho | p | Spearman's rho | p | Spearman's rho | p |
| SANS | | | | | | | | | | |
| Total[a] | 0.763 | <0.001 | 0.392 | <0.001 | 0.364 | <0.001 | 0.277 | <0.001 | 0.815 | <0.001 |
| Affective flattening | 0.566 | <0.001 | 0.157 | 0.009 | 0.140 | 0.021 | 0.086 | 0.156 | 0.914 | <0.001 |
| Alogia | 0.540 | <0.001 | 0.284 | <0.001 | 0.219 | <0.001 | 0.131 | 0.030 | 0.668 | <0.001 |
| Avolition-apathy | 0.496 | <0.001 | 0.220 | <0.001 | 0.548 | <0.001 | 0.262 | <0.001 | 0.307 | <0.001 |
| Anhedonia-Asociality | 0.629 | <0.001 | 0.583 | <0.001 | 0.300 | <0.001 | 0.434 | <0.001 | 0.308 | <0.001 |
| Attention | 0.252 | <0.001 | 0.101 | 0.095 | 0.1115 | 0.058 | 0.132 | 0.028 | 0.245 | <0.001 |
| PANSS | | | | | | | | | | |
| Negative | 0.631 | <0.001 | 0.365 | <0.001 | 0.287 | <0.001 | 0.163 | 0.007 | 0.631 | <0.001 |
| Positive | 0.092 | 0.130 | 0.102 | 0.093 | 0.090 | 0.138 | 0.023 | 0.705 | 0.040 | 0.509 |
| Depression, G6 | 0.103 | 0.090 | 0.096 | 0.114 | 0.022 | 0.717 | 0.090 | 0.137 | 0.091 | 0.134 |
| CDSS total | 0.097 | 0.110 | 0.130 | 0.032 | 0.034 | 0.571 | 0.134 | 0.026 | −0.014 | 0.822 |
| SES total | 0.255 | <0.001 | 0.062 | 0.306 | 0.089 | 0.141 | 0.075 | 0.214 | 0.367 | <0.001 |

Abbreviations: CAINS, Clinical Assessment for Negative Symptoms; MAP, Motivation-Pleasure; EXP, Expression; SANS, Scale for Assessment of Negative Symptoms; PANSS, Positive and Negative Syndrome Scale; CDSS, Calgary Depression Scale for Schizophrenia; SES, Simpson-Angus EPS Scale.
[a] Global scores not included.

because they are based on patient's self-report of his activities and behaviors, without consideration of his internal desires or motivation (Azorin et al., 2014; Elis et al., 2013), and hence negative symptoms could have more than two underlying domains.

The 4-factor structure shown in our results is consistent with a recent publication on structure of negative symptoms by Ahmed et al. (2018) which suggested that the 2-factor model of negative symptoms may be premature, especially since most of the prior relevant studies used only EFA, and did not validate their exploratory models using CFA. In their study, Ahmed et al. (2018) used a contemporary negative symptom rating scale called the Brief Negative Symptom Scale (BNSS), and conducted a CFA to externally validate their EFA-derived model of the BNSS. The findings from this study supported a 5-factor structure of the BNSS across various study samples, rather than the 2-factor structure suggested by most of the previous research (Mane et al., 2014; Mucci et al., 2015; Strauss et al., 2012). Similarly, most of the CAINS factor-analytic studies so far have employed only EFA on their data to derive the CAINS factor structure (Chan et al., 2015; Engel et al., 2014; Jung et al., 2016; Kring et al., 2013; Valiente-Gomez et al., 2015).

Our study results suggested good internal consistency of the CAINS and its factors; this is consistent with the previous reports (Chan et al., 2015; Engel et al., 2014; Jung et al., 2016; Kring et al., 2013; Valiente-Gomez et al., 2015). Further, the CAINS showed strong correlations with PANSS Negative subscale scores and SANS total scores, exhibiting good convergent validity. With regards to the CAINS factors, correlation was highest between the CAINS EXP and PANSS DEE factors. This was expected since both these factors have overlapping expression items, and are rated based on observation by the interviewer. However, the PANSS SA factor showed only moderate correlation with the MAP social factor, which could be because MAP social items include items measuring consummatory and anticipatory pleasure in social activities, and consider both internal desire and behavior manifestation in social interaction, whereas PANSS SA items do not include such information. SA items in PANSS emphasize on social interaction manifested mainly by behavior and do not measure the component of anhedonia related to social activities. The results of correlations with SANS were intuitive, with highest correlations between MAP social and recreational factor scores and SANS anhedonia-asociality scores, MAP vocational scores and SANS avolition-apathy scores, and EXP scores with SANS affective flattening scores.

Good divergent validity of the CAINS was shown by insignificant correlations between CAINS scores and PANSS positive subscale and CDSS scores, and weak correlations with SES total scores. This suggests that CAINS can distinguish negative symptoms from depressive symptoms and drug related side effects in schizophrenia.

We also found that negative symptoms measured by the CAINS total correlated strongly and inversely with functioning. MAP social and vocational factor scores showed moderate negative correlations with SOFAS scores. This is in line with previous study reports that suggest that the MAP domain of the CAINS is related to independent living and family and social functioning (Engel et al., 2014; Kring et al., 2013). Negative symptoms are associated with impairments in both adaptive and cognitive functioning in schizophrenia (Fervaha et al., 2014; Herbener and Harrow, 2004). Moreover, previous research on individuals with first episode psychosis has shown that improvement in negative symptoms is associated with improvement in functioning (Alvarez-Jimenez et al., 2012; Cassidy et al., 2010), suggesting that the early identification and management of negative symptoms in schizophrenia is crucial for a favorable functional outcome.

Our study is one of the initial studies examining the validity of the CAINS in assessment of negative symptoms in an Asian population. Our total sample size is larger than many of the previous relevant studies on CAINS (Chan et al., 2015; Engel et al., 2014; Jung et al., 2016; Kring et al., 2013; Valiente-Gomez et al., 2015). The main limitation of our study is that we did not assess test-retest and interrater reliability. Also, data was collected only via participants' interviews; inclusion of other methods like self-rated measures or caregiver ratings could have given us a broader perspective on negative symptoms of the participants. In conclusion, our study results suggested that the CAINS has good psychometric properties and can be used by clinicians to evaluate negative symptoms in individuals with schizophrenia in the local population. Further research is needed to explore the structure of the negative syndrome in schizophrenia.

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**Contributors**
Dr. Rekhi and Dr. Lee were involved in the design of the study. Dr. Rekhi managed the literature searches and analyses, and prepared the first draft of the manuscript. Dr. Rekhi and Ms. Ang were involved in data collection. Dr. Rekhi, Ms. Ng, Ms. Ang and Ms. Yuen undertook statistical analyses and interpretation. Dr. Lee and Ms. Ang gave substantial comments and edited the first draft. All authors have contributed to and have approved the final manuscript.

**Conflict of interest**
The Authors declare that they have no conflicts of interest in relation to the subject of this study.

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