Usefulness of the CAPE-P15 for detecting people at ultra-high risk for psychosis: Psychometric properties and cut-off values

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Abstract

A need for a brief, easy to complete self-report questionnaire to detect people at ultra-high risk for psychosis (UHR) in busy clinical settings has been recognised. Our aim was to explore whether the Community Assessment of Psychic Experiences – Positive 15-items Scale (CAPE-P15) could be used as a screening tool to identify people at UHR in a clinical setting. Our objectives were to confirm the CAPE-P15 factorial structure as well as its reliability and determine cut-off values for the detection of such individuals using the Comprehensive Assessment of At-Risk Mental States (CAARMS), a commonly used clinical interview for the detection of UHR. 165 participants aged between 13 and 18 referred to the General Hospital of Vienna were included in the analysis. 50.9% of the sample were "CAARMS-positive" and 49.1% "CAARMS-negative". The Youden method determined CAPE-P15 cut-off values for UHR detection of 1.47 for both frequency of and distress associated with psychotic experiences. The cut-off value of 1.47 for frequency showed sensitivity of 77%, specificity of 58%, a positive predictive value of 66% and a negative predictive value of 71%; whilst for distress it showed sensitivity of 73%, specificity of 63%, a positive predictive value of 69% and a negative predictive value of 66%. Good reliability and the previously suggested three-correlated factor model as well as an alternative bi-factor model of the CAPE-P15 were confirmed. The CAPE-P15 seems to be a promising screening tool for identifying people who might be at UHR in busy clinical settings.

Keywords: CAARMS, CAPE, CAPE-P15, Psychosis, Screening, Ultra-high risk.

1. Introduction

So far the most commonly used instruments to detect individuals at ultra high-risk for psychosis (UHR) are structured clinical interviews, such as the Comprehensive Assessment of At-Risk Mental States (CAARMS) (Yung et al., 2005). However, as pointed out by Addington et al. (2015), these tools may have limited practicality for primary identification of people at UHR in busy clinical settings, where time constraints are high and specifically trained interviewers may not always be available. Thus, the use of the briefest possible, easy to complete self-report questionnaire to allow identification of individuals at UHR would be recommended.

One of the self-report instruments with a potential to be used as a screening tool to detect UHR is the Community Assessment of Psychic Experiences (CAPE) (Stefanis et al., 2002). Designed to measure lifetime psychotic experiences in the general population, the CAPE has become one of the most widely used instruments, not only in the community but also clinical settings. Reasons include its relative brevity and predictive power for adverse mental health outcomes. By mid-2015, an independent review identified 111 studies using the CAPE, covering samples ranging from 22 to 47,859 subjects across 15 different countries (Mark & Toulopoulou, 2016). The original CAPE comprised 42 items (CAPE-42); three subscales/dimensions assessed positive, depressive and negative symptoms (Stefanis et al., 2002). Good discriminate validity (Addington et al., 2015, Hanssen et al., 2003; Mark & Toulopoulou, 2016; Stefanis et al., 2002) and adequate test-retest reliability (Konings et al., 2006) have been reported for the three dimensions. Notably, the positive subscale (CAPE-P), comprising 20 items, most strongly detects psychotic experiences and predicts psychotic illness better than the whole 42-item scale; it has good internal consistency ($\alpha = 0.82$) (Addington et al., 2015; Brenner et al., 2007; Mark & Toulopoulou, 2016).

Interestingly, neither the CAPE-42 nor the CAPE-P originally set cut-points to determine clinically significant psychotic experiences or UHR, but simply reported dimensional measurements of psychotic-like phenomena. This significantly reduced its clinical usefulness as a screening tool. In 2012, we tested the utility of the full CAPE questionnaire and the CAPE-P as a screening tool for UHR using the CAARMS as a gold standard. We established cut-off points for the CAPE-P subscale in adolescents referred to the Department of Child and Adolescent Psychiatry of the General Hospital of Vienna (Mossaheb et al., 2012). Since then, studies using the CAPE-P have found a stable sub-structure with 3-5 factors; with specific subtypes of psychotic experiences differentially related to distress, depression and poor functioning (Mark & Toulopoulou, 2016). Capra et al. (2013) determined that a three-correlated factor model yielded the best fit when items addressing magical thinking, grandiosity, and paranormal beliefs were excluded. The proposed factors were labelled as bizarre experiences (BE), persecutory ideation (PI) and perceptual abnormalities (PA). This resulted in an even shorter subscale, the CAPE-P15, which solved many problems encountered by prior research related to the omitted items (misinterpretation, cross-loading and ambiguous association with psychopathology) (Núñez et al., 2015).

Using the same sample as in Mossaheb et al.'s study (2012), we aimed to determine the usefulness of the CAPE-P15 to detect UHR in clinical populations. Our objectives were: [1] To confirm the CAPE-P15 factorial structure as well as its reliability and [2] determine cut-off values for the detection of such individuals in clinical settings.

2. Methods

2.1. Participants

This study was conducted with 256 individuals aged 13-18 years, who were referred directly for an assessment at the Psychosis Detection Unit of the Department of Child and Adolescent Psychiatry, General Hospital of Vienna, between May 2004 and June 2006. Most patients are referred to this unit from other outpatient mental health services. Some referrals are also made by clinicians working in inpatient wards, or by private mental health professionals . Patients are not pre-screened at the unit; they are referred for assessment when symptoms, such as perceptual abnormalities or paranoid/unusual thoughts, may suggest a mental state at UHR (Amminger et al., 2010).

2.2. Procedure

The Medical University of Vienna Ethics Committee approved the study. The suspected risk for the development of a psychotic disorder was assessed using the CAARMS. Patients were asked to complete the CAPE-42 questionnaire before the CAARMS interview was conducted. One hundred and ninety-one (74.6%) of them agreed to participate. The exclusion of respondents who returned incomplete questionnaires (n=2), did not meet the age criteria (9) or who already fulfilled criteria for psychosis (15) resulted in the final sample of 165 individuals. From the remaining respondents, 84 (51%) were “CAARMS-positive” and 81 (49%) were “CAARMS-negative”. The CAARMS-interviewer was blind to the results of the CAPE.

2.3. Measures

2.3.1. CAPE-P15

This is a 15-item, self-report measure of experiences that are similar to positive psychotic symptoms, such as paranoid beliefs or hallucinations. It measures both frequency of and distress associated with these experiences. Responses to items regarding frequency range from 1 - never, 2 - sometimes, 3 - often, to 4 - nearly always; for distress items range from 1 - not distressed, 2 - a bit distressed, 3 - quite distressed to 4 - very distressed.

To account for non-response to any items, scores are weighted for the number of valid answers. The weighted score is the sum score divided by the number of items completed. Higher scores indicate a higher frequency of psychotic experiences and an increased level of distress in relation to these experiences.

Originally, participants were assessed with the CAPE-42 (Stefanis et al., 2002). P. Domen's German translation of the CAPE was used (van Os et al., 1999). To address the aim of the study only the 15 items that corresponded to the CAPE-P15 were used in our analysis. As stated above, the CAPE-P15 items belong to 3 subscales: PA (3 items), PI (5 items) and BE (7 items).

2.3.2. CAARMS

The Comprehensive Assessment of At-Risk Mental States (CAARMS, Yung et al. 2005) is a semi-structured interview designed to identify people who are at UHR for psychosis and requires to be administered by a specifically trained mental health professional.

According to the CAARMS criteria, a patient was classified as either psychotic (or had a lifetime diagnosis of a psychotic disorder), UHR for psychotic disorder, or neither of both prior categories. Those identified as being at UHR met at least one of the following criteria:
1) Experienced attenuated psychotic symptoms.
2) Experienced Brief Limited Intermittent Psychotic Symptoms (BLIPS).
3) Experienced non-specific symptoms (e.g. lowered mood or anxiety) for at least one month associated with significantly impaired functioning and had a schizotypal personality disorder or a family history of a psychotic disorder in a first-degree relative.
The criteria are described in more detail by Yung et al. (2003).

2.4. Statistical Analyses

Inter-item correlations of the CAPE-P15 were visualized as a graphical network using Fruchterman – Reingold algorithm (Fruchterman and Reingold, 1991). The closer nodes (items) are more correlated. The thickness of lines connecting the nodes (i.e. edges) is proportionate to the size of the correlation; no edge is present when corresponding correlations fall below 0.3 in absolute value. The colour of the edge denotes its sign (green=positive, red=negative). Based on this figure, we hypothesised alternative models to the three-correlated factor model of the CAPE-P15 and subsequently empirically tested all of them using Confirmatory Factor Analysis (CFA). All models were estimated twice; [1] using mean and variance adjusted weighted least squares (WLSMV) to obtain absolute fit indices and [2] Full Information Maximum Likelihood (FIML) to determine Akaike Information Criterion (AIC) and sample size adjusted Bayesian Information Criterion (BIC), which allow direct comparison of alternative models. Lower bound of the reliability of frequency and distress scores were assessed by McDonald's omega (McDonald, 1999). We also computed Cronbach's alpha internal consistency (Cronbach, 1951) and estimated the graded response model (Samejima, 1969) in order to examine measurement error in detail.

Receiver operating characteristic (ROC) analysis (Robin et al., 2012) was used to assess the utility of the CAPE-P15 for identifying UHR individuals. A different approach to establishing cut-off points was undertaken in this study, choosing not to calculate a composite score as it was done previously for the CAPE-P (Mossaheb et al., 2012). Separate receiver operating characteristic (ROC) curves were constructed for the CAPE-P15 frequency and distress dimensions to predict CAARMS negative vs CAARMS positive diagnosis. This intended to add clinical value and follows the original CAPE design, which did not consider combined but only separate values for frequency of and distress associated with psychotic experiences. Optimal cut-off points for frequency and distress scores were established according to Youden method. We also determined points in ROC curves which were closest to the top-left corner. Sensitivity, specificity, positive and negative predictive values were calculated. Analyses were performed using the statistical package “R” (R Core Team, 2013) and MPlus 7.4 (Muthén & Muthén, 1998–2016).

3. Results

3.1. Descriptive statistics

Mean age in the total sample was 16.2 years (Standard Deviation (SD) = 2.48). 58.2% of the total sample were females (n = 96) with mean age of 16.35 (SD = 2.54). The CAPE-P15 score distribution was not normal; Table 1 shows descriptive statistics for the CAPE-P15 total as well as subscale scores. Mean total frequency score was 1.69 (SD = 0.47; median = 1.6) and mean distress score was 1.65 (SD = 0.53; median = 1.5).

[Table 1 about here]

3.2. Construct validity

Correlation between frequency and distress scores was strong ($r_s = 0.89$, $p < 0.001$).

Graph theory methods were used to examine the pattern of connections of the CAPE-P15 items (See Figure 1). All of them were correlated positively. However, items from BE and PA subscales appeared to be highly interrelated, suggesting that they might belong to one factor. On the basis of this, the following alternative factorial models for the CAPE-P15 were tested in order to evaluate whether any of them provided a better fit than the three-correlated factor model: [1] Two-correlated factors where the first factor is identical to PI and the second one is comprised of BE and PA items; [2] a unidimensional model; and [3] a bi-factor model (Reise, 2012) with a general factor (G factor) and three specific factors for PI, BE and PA.

[Figure 1 about here]

All models showed acceptable fit to the data. CFA revealed that the three-correlated-factor model provided a good fit; however, a bi-factor model with three specific factors and a G factor yielded the best absolute fit to our data. Also, it was the best fitting model from our three alternative models according to AIC; BIC was slightly lower (better) for the unidimensional model (See Table 2).

[Table 2 about here]

The standardised loadings of the three-correlated factor model ranged from 0.59 to 0.93 and the correlations between factors varied from 0.64 to 0.76. In the bi-factor model, loadings of the G factor ranged from 0.45 to 0.73 across the 15 items. The G factor loadings were larger than those of the three specific factors, especially BE, for most items. This means that, in the bi-factor model, these items may be considered a better measure for the underlying G factor than for specific factors (See Table 3).

[Table 3 about here]

3.3. Internal consistency, reliability and measurement error

Internal consistency was examined using Cronbach's alpha. McDonald's omega coefficients were calculated to estimate reliability. Coefficients were computed for the CAPE-P15 total score and the three subscales for frequency and distress dimensions separately. Omega values ranged from 0.73 to 0.93 (See Table 4).

Measurement error as a function of a standardised score is presented in Figure 2. It was reasonably small (< 0.3 SD) for a wide range of score distribution in our clinical population (appr. -1 to 3 SDs). The smallest error for both frequency and distress was around 1 SD above the mean. This indicates that the scale is well suited for detecting people with higher severity.

[Table 4 about here]

[Figure 2 about here]

Since our factor analysis supported a bi-factor model for the CAPE-P15, omega and omega hierarchical coefficients were also calculated for the general and three specific factors. Omega values for all factors were high (G = 0.92, PI = 0.80, BE = 0.87 and PA = 0.87) and the relevance of the G factor was further confirmed by an omega hierarchical value of 0.83. For the three specific factors these coefficients were significantly lower (PI = 0.23, BE = 0.15 and PA = 0.30). This suggests that the initial reliability of specific factors as indicated by high omega values is due to the G factor's influence. Accordingly, the use of a total score seems an appropriate choice as it reflects an underlying general trait measured by the questionnaire (Reise et al., 2010).

3.4. Thresholds for identification of UHR

The area under the curve was similar for frequency (AUC = 0.69, 95% CI = 0.61-0.77) and distress (AUC = 0.71, 95% CI = 0.63-0.79) scores. Optimal cut-off points were first calculated according to the Youden method, which maximises the sum of sensitivity and specificity. Results are presented in Figure 3. A cut-off value of 1.47 was found to identify "caseness" best for both frequency and distress scores. For frequency scores it showed sensitivity of 77%, specificity of 58%, a positive predictive value of 66% and a negative predictive value of 71%, while for distress scores it demonstrated sensitivity of 73%, specificity of 63%, a positive predictive value of 69% and a negative predictive value of 66%.

[Figure 3 about here]

Cut-off points were also obtained by calculating the value for which the point on the ROC curve had the minimum distance to the upper left corner. This method yielded similar results to those obtained by Youden method. The cut-off value of 1.53 for frequency scores showed a lower sensitivity (69%), but a higher specificity (64%). As for distress scores, the same cut-off value of 1.47 was found to identify "caseness" best with a sensitivity of 74%, resulting in a specificity of 63%.

4. Discussion

The main aim of this study was to explore the diagnostic utility of the CAPE-P15 to detect UHR individuals by examining its psychometric properties and setting cut-off values according to the CAARMS interview.

Our results indicate that the CAPE-P15 is a brief measurement instrument with good reliability and strong construct validity. We found high McDonald's Omega coefficients and small measurement error for a wide range of score distribution, which supports its use as a screening tool with good measurement precision. High Cronbach's alpha values (0.85 and 0.86 for frequency and distress dimensions respectively) are in accordance with the internal consistency score reported for the CAPE-P15 by other researchers (0.79) (Capra et al., 2013). Graph theory based network of the CAPE-P15 revealed correlations between all items, which were particularly strong between the BE and PA subscales' items. We confirmed the three-correlated factor structure of the CAPE-P15 proposed by Capra et al. (2013) and recently replicated in a sample of non-help-seeking adolescents (Núñez et al., 2015). However, a bi-factor model (Reise, 2012), with a G factor underlying three specific factors for PI, BE and PA, showed superiority over the three-correlated factor model. This G factor justifies the use of a CAPE-P15 mean total score rather than individual scores for each subscale.

We identified the CAPE-P15 cut-off value for UHR detection of 1.47 for both frequency of and distress associated with psychotic experiences. The CAPE-P15 was found to have a sensitivity of 77% and 73% for frequency and distress scores respectively, which is slightly lower than the sensitivity of the CAPE-P (83%) (Mossaheb et al., 2012). Despite this, the CAPE-P15 is characterised by higher specificity (58% for frequency and 63% for distress) in comparison to the CAPE-P (49%), leading to a lower rate of false positives. In practice, we would suggest a more convenient cut-off value of 1.5 for both dimensions. Although our results showed a strong correlation between frequency and distress scores, we deliberately chose not to calculate a cut-off value for a composite total score. This decision follows the original CAPE design and considers the clinical importance of distress caused by symptoms for establishing a diagnosis of UHR. Hence, only those individuals experiencing frequent symptoms with associated marked distress would be considered above the threshold.

Our findings add to the evidence that the CAPE-P15 could be a helpful tool for screening individuals that might be at UHR in busy clinical settings where conducting structured interviews is difficult due to time constraints and/or the lack of trained staff. Considering that the CAPE-P15 only measures psychotic experiences (the positive dimension), it might be better implemented as a primary screening tool that could be followed by more structured diagnostic interviews. This should allow measuring other dimensions of psychopathology also related to an increased risk of developing psychosis in people already identified as having clinically relevant psychotic experiences according to the CAPE-P15. The CAPE-P15 questionnaire is a promising alternative to other brief self-report screening tools that are currently employed to detect UHR, such as the PRIME-Screen Revised (PS-R; Kobayashi et al. 2008), Prodromal Questionnaire – Brief version (PQ-B) (Loewy et al., 2011) or the 16-item version of the Prodromal Questionnaire (PQ-16; Ising et al., 2012). Its strong construct validity, detailed analyses of its factorial structure, internal consistency (similar to PQ-B (Loewy et al., 2011) and PS-R (Kobayashi et al., 2008) and superior to PQ-16 (Ising et al., 2012)) and the fact that it measures both symptom frequency and associated distress (PS-R focuses on symptom duration and both PQ-B and PQ-16 on distress) may indicate some advantages over the other options.

A potential limitation of this study is that the participants had originally completed the full length CAPE questionnaire (42 items) and not the CAPE-P15. It is difficult to know how this might have influenced the results. Answering a longer questionnaire may be more tiring; thus, the internal consistency could have increased if the data were obtained from the shortened version. Since we explored the psychometric properties of the CAPE-P15 in an adolescent clinical sample, another limitation relates to the generalisability of our findings. For instance, screening in non-clinical or primary care settings may require different cut-off values; however, our evaluation of its diagnostic utility in a secondary care clinical sample provides a valuable reference for future studies involving other populations. A new version of the CAPE-P15 has been recently introduced to measure recent instead of lifetime psychotic experiences (Capra et al., 2015). It would be worth exploring if the updated instrument demonstrates the same or even better psychometric properties as it may have greater current clinical relevance, especially in older people, whose lifetime psychotic experiences may not be as recent as in younger, adolescent populations.

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