Self-perceived cognitive impairments in psychosis ultra-high risk individuals: associations with objective cognitive deficits and functioning

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There is a scarcity of evidence on subjectively reported cognitive difficulties in individuals at ultra-high risk (UHR) for psychosis and whether these self-perceived cognitive difficulties may relate to objective cognitive deficits, psychopathology, functioning, and adherence to cognitive remediation (CR). Secondary, exploratory analyses to a randomized, clinical trial were conducted with 52 UHR individuals receiving a CR intervention. Participants completed the Measure of Insight into Cognition—Self Report (MIC-SR), a measure of daily life cognitive difficulties within the domains of attention, memory, and executive functions along with measures of neuropsychological test performance, psychopathology, functioning, and quality of life. Our study found participants with and without objectively defined cognitive deficits reported self-perceived cognitive deficits of the same magnitude. No significant relationship was revealed between self-perceived and objectively measured neurocognitive deficits. Self-perceived cognitive deficits associated with attenuated psychotic symptoms, overall functioning, and quality of life, but not with adherence to, or neurocognitive benefits from, a CR intervention. Our findings indicate that UHR individuals may overestimate their cognitive difficulties, and higher levels of self-perceived cognitive deficits may relate to poor functioning. If replicated, this warrants a need for both subjective and objective cognitive assessment in at-risk populations as this may guide psychoeducational approaches and pro-functional interventions. Self-perceived cognitive impairments do not seem to directly influence CR adherence and outcome in UHR states. Further studies are needed on potential mediator between self-perceived cognitive deficits and functioning and quality of life.

**INTRODUCTION**

Individuals at ultra-high risk (UHR) for psychosis are characterized by persistent cognitive deficits within both global and specific cognitive domains1–6. Meta-analytical evidence has revealed moderate overall impairments in neurocognition in UHR compared to healthy controls (Hedges’ $g = -0.344$)7. Additionally, the severity of neurocognitive impairments are found to be intermediate between that of patients with schizophrenia and healthy controls3,7. Neurocognitive deficits in UHR have been implicated in psychosis development8,9 and poor functional outcome9,10.

As performance-based cognitive testing is the preferred assessment measure employed in psychosis research, few studies have elucidated on patient’s self-perceived cognitive impairments: in general, the studies do not find an association between objective and subjective neurocognitive deficits in patients with established psychosis11–14. To the best of our knowledge, no previous study has, however, investigated whether this discrepancy between objective and subjective cognitive deficits also apply to the UHR state of psychosis.

Cognitive remediation is one of the most promising interventions to alleviate cognitive deficits, with proven effectiveness in first-episode and more chronic states of psychosis with small to medium effect sizes on cognitive and functional outcomes15–21. The existing, albeit small, literature does not indicate awareness of cognitive deficits is a pre-requisite for positive outcome of a cognitive remediation intervention in schizophrenia12,14. While considerably less studied, preliminary data indicate efficacy of cognitive remediation in the UHR state of psychosis22, but it remains, however, unclear whether self-perceived cognitive deficits may influence adherence to cognitive remediation in the UHR population. That is, whether higher levels of subjectively reported cognitive deficits will relate to UHR individuals adhering to and engaging in a cognitive remediation intervention.

By using data from the hitherto largest randomized, clinical trial (FOCUS trial)23 on cognitive remediation in the UHR population, we conducted secondary, exploratory analyses aimed at investigating the relationship between self-perceived neurocognitive deficits and objective cognitive performance, psychopathology, functioning, and adherence to a cognitive remediation intervention. The study addressed the following questions: (1) Is there a relationship between subjective and objective cognitive deficits in UHR individuals? (2) Is there an association between subjectively reported cognitive deficits and clinical symptoms and functioning/quality of life? (3) Do self-perceived cognitive deficits associate with adherence to and benefit from a cognitive remediation intervention?

**RESULTS**

Out of the 73 UHR individuals randomized to the cognitive remediation interventions, 52 (71%) completed the MIC-SR. Reasons for not completing the MIC-SR were: drop-out before starting the cognitive remediation intervention ($n = 8$), or lack of time to complete MIC-SR ($n = 13$). Analyses revealed that the...
The one-way ANOVA revealed that the 32 UHR individuals (including both group- and homebased training) had an average of 11.9 (SD 16.4) h of neurocognitive training and a total 20 sessions of neuro- and social cognitive remediation and cognitive deficits more than once a week. Participants displaying objective cognitive impairments and a MIC-SR average frequency score of 1.9 (SD .60). Participants not displaying cognitive deficits had a mean MIC-SR total score of 23.4 (SD 7.1) and a MIC-SR average frequency of 1.7 (SD 1.35), which has been reported to indicate borderline to attenuated psychotic symptoms. That is higher scores on the self-perceived cognitive impairments measure associated with greater severity of attenuated psychotic symptoms and lower functioning. The MIC-SR explained 10%, 7%, and 4% of variance in symptoms, functioning and quality of life, respectively.

Relationship between self-perceived cognitive deficits and clinical symptoms, functioning and quality of life
Regression analyses revealed baseline MIC-SR to associate with estimated IQ, verbal IQ, performance IQ, or years of education. Estimated IQ was, however, significantly related to the BACS composite score.

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DISCUSSION
In keeping with previous literature in psychosis and other psychiatric disorders such as depression and bipolar disorder, we did not find a significant association between subjective and objectively measured cognitive deficits in UHR individuals. This discrepancy could reflect general difficulties in self-evaluation in psychotic disorders, or it could reflect the notion that self-reported scales are not affected by the appearance of the individual daily life. This potential of measures of subjective and objective cognitive deficits tapping different aspects of cognition is further reflected in the finding of participants not displaying objective cognitive deficits on the MIC-SR total score (p = 0.11). Neither did the Spearman’s correlation analyses reveal a significant baseline correlation between the MIC-SR total score and the BACS composite score (rho = −0.12, p = 0.39).

Additional analyses revealed that the MIC-SR total score did not significantly relate to estimated full scale IQ, verbal IQ, performance IQ, or years of education. Estimated IQ was, however, significantly related to the BACS composite score.

At baseline, the UHR group reported experiencing cognitive impairments, with self-reported measures having greater variance in the individuals daily life. This potential of measures of subjective and objective cognitive deficits tapping different aspects of cognition is further reflected in the finding of participants not displaying objective cognitive deficits on the MIC-SR total score (p = 0.11). Neither did the Spearman’s correlation analyses reveal a significant baseline correlation between the MIC-SR total score and the BACS composite score (rho = −0.12, p = 0.39).

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subjective cognitive deficits being unrelated to estimated IQ, while objective cognitive deficits (BACS composite score) were significantly related. Furthermore, our study found UHR individuals to report self-perceived cognitive deficits of a magnitude exceeding that of patients with established psychosis (mean MIC-SR total score in UHR = 21/SD = 7, schizophrenia = 14.0/SD = 9.7 and 13.9/SD = 9.4)\(^{12,14}\). This is rather surprising as UHR individuals in general display performance-based cognitive deficits of a smaller magnitude than patients with schizophrenia\(^7\). Additionally, a little over one-third (39%) of our sample was not found to be cognitively impaired on the performance-based neurocognition measure but still reported self-perceived cognitive impairments in the same range as those with established cognitive deficits. This contrasts some studies in schizophrenia finding that a substantial number of patients do not have an awareness of cognitive deficits even in the presence of objectively measured deficits\(^12,13,30\). This discrepancy indicates that while patients with schizophrenia may underestimate their level of cognitive deficits, UHR individuals may overestimate their cognitive difficulties. Speculating, this could potentially cause UHR individuals to experience defeatist beliefs and lead to daily-life functional impairments\(^31,32\). Adding weight to this hypothesis is our cross-sectional finding of self-perceived cognitive difficulties being adversely associated with overall functioning and quality of life explaining 7% and 22% of the variance on these functioning measures, respectively. This warrants a need for future studies investigating whether potential mediators such as defeatist beliefs or perceived competence may mediate the relationship between self-perceived cognitive impairments and functional decrements. Furthermore, it suggests a need for assessing both self-perceived and actual cognitive deficits in UHR groups. In cases of discrepancy between these domains, psychoeducation on cognitive deficits and a focus on cognitive strengths and resilience could be instituted. While this is, to our knowledge, the first study to elucidate on subjective neurocognitive deficits in a UHR population, a previous study has assessed self-perceived social cognitive impairments in a UHR sample finding a correlation between subjectively experienced cognitive deficits and decrements in role functioning\(^33\) which further supports the existence of a link between self-perceived cognitive deficits and functioning in UHR.

Regarding the relationship between self-perceived cognitive deficits and psychopathology, we found a significant association with attenuated psychotic symptoms, but not depressive or negative symptoms. This contrast findings from patients with schizophrenia of significant associations between self-perceived and clinician-rated cognitive impairments and depressive, but not positive (or negative) symptoms\(^12,30\). These findings from schizophrenia samples have indicated that those with higher depressive scores may have greater awareness of cognitive dysfunctions which echoes reports of correlations between depressive symptoms and better insight into psychosis\(^54\). Findings are, however, mixed, as another study reported less severe depressive symptoms in schizophrenia samples with better insight into neurocognitive deficits\(^47\). Our finding of an association between self-perceived cognitive impairments and attenuated psychotic symptoms are in accordance with a previous report from a UHR sample, albeit this relationship was observed between self-perceived social cognitive deficits and attenuated psychotic symptoms\(^33\). It does, however, contrast with the essentially weak relationship found between performance-based neurocognition and attenuated- and fully psychotic symptoms\(^35–37\). Hypthesizing, our finding may suggest that some UHR individuals may be inclined to perceive daily life cognitive impairments in areas such as attention, memory, and problem-solving influence level of subthreshold psychotic symptoms (which includes disorganization), or vice versa.

Lastly, this study aimed to elucidate on the relationship between baseline subjective cognitive deficits and adherence to, and benefits from, a cognitive remediation intervention in UHR. We did not find that self-perceived cognitive difficulties were significantly associated with attendance, adherence, or engagement in a cognitive remediation intervention. Neither did it significantly associate with change scores on the global neurocognitive outcome. In previous reports from patients with schizophrenia, poor insight into neurocognitive deficits has not been adversely related to cognitive remediation attendance, treatment satisfaction\(^13\), or cognitive benefits\(^13,14\), although it may impact engagement in treatment via its interaction with perceived competency, a motivational construct that promotes treatment engagement\(^14\).

While being the hitherto largest RCT on cognitive remediation in the UHR population, our study is limited by a relatively small sample completing the MIC-SR (N = 52). Furthermore, the RCT study was not designed, nor potentially adequately powered, to address the current research question, which warrants a need for future well-powered studies investigating self-perceived cognitive deficits in response to a cognitive remediation intervention in UHR states. Finally, the study enrolled adults at UHR for psychosis, and while this is similar to other large-scale UHR research studies\(^39–41\), the age range is somewhat older than many other UHR studies\(^39–41\), which may limit the generalizability of the findings to the entire UHR population.

To conclude, our study extends previous findings from schizophrenia and other psychiatric populations of a lack of relationship between objectively and subjectively measured neurocognitive deficits to the population of individuals at UHR for psychosis. Also, our results suggest that UHR individuals may overestimate their level of cognitive deficits indicating this to be a target of psychoeducational approaches. Additionally, we found self-perceived cognitive deficits to associate with overall functioning and quality of life which, if replicated, point towards a target for pro-functional intervention approaches. Future research would benefit from investigating whether psychological aspects such as defeatist beliefs and perceived competence could serve as potential mediator between self-perceived cognitive deficits and functional outcome and benefits from a cognitive remediation intervention in UHR. Finally, we did not find baseline self-perceived cognitive deficits to relate to engagement in- or outcome of cognitive remediation in UHR indicating that subjectively experienced cognitive deficits do not seem to constitute a suitable clinical selection-based criterion of whether individuals should be offered a cognitive remediation intervention.

| Table 3. Spearman’s correlations between Measure of Insight into Cognition—Self Report (MIC-SR) total score and adherence to and outcome of a cognitive remediation (CR) intervention in UHR individuals (N = 52). |
|---------------------------------------------------------------|
| Neurocognitive training hours | CR sessions attended | Drop-out CR | BACS composite change scores |
| MIC-SR rho = 0.002 | rho = 0.029 | rho = 0.177 | rho = 0.010 |
| p = 0.988 | p = 0.842 | p = 0.215 | p = 0.949 |
METHODS

Study design

A detailed description of the original study can be found in ref. 44. Briefly described, participants were recruited to the randomized clinical, FOCUS trial from the psychiatric in- and outpatient facilities in the greater catchment area of Copenhagen, Denmark from April 2014 to December 2017. On completion of baseline assessments, the participants were randomly assigned to either 20-weeks of cognitive remediation as an add on to treatment as usual (TAU + CR) or to treatment as usual (TAU). The cognitive remediation intervention comprised 2 h of group training (1 h of neurocognitive training, with subsequent 15 min of bridging session, and 1 h of social cognitive training) once a week for a total of 20 weeks. The cognitive remediation targeted both neuro- and social-cognition using the manualized, evidence-based treatments; the Neuropsychological Educational Approach to Cognitive Remediation (NEAR)45 and the Social Cognition and Interaction Training (SCIT) manual46. Supplementary to the group training, the participants received 12 individual sessions to personalize and maximize the transfer of the effect of the cognitive training to the participants’ daily lives. In addition, participants were encouraged to conduct a minimum of 1-h weekly of home-based neurocognitive training. The neurocognitive training was scaled to comprise 40 h of neurocognitive remediation, expecting that each participant attended the 20-group sessions and did the recommended 1-h weekly of home-based training.

The study protocol was approved by the Committee on Health Research Ethics of the Capital Region Denmark (study: H-6-2013-015). All participants provided written informed consent prior to inclusion in the study. Trial registration ClinicalTrial.gov identifier: NCT02098408.

Participants

The sample consisted of 146 help-seeking individuals aged 18–40 years, who met one or more UHR criteria according to the Comprehensive Assessment of At-Risk Mental States47: attenuated psychotic symptom group; brief limited intermittent psychotic symptoms group; and/or trait and vulnerability group along with a significant drop in functioning or sustained low functioning for the past year.

Assessments

The demographic information assessed in the study comprised age, years of education, and estimation of current IQ, with the latter assessed using four subtests from the Wechsler Adult Intelligence Scale - Third Edition (WAIS-III)48. Vocabulary, Similarities, Block Design, and Matrix Reasoning.

Self-perceived cognitive deficits

The Measure of Insight into Cognition—Self Report (MIC-SR)12,49 was used to assess self-perceived cognitive impairments. The MIC-SR comprises 12 items on daily life difficulties with memory, attention, and problem solving. Each of the 12 items are given a score of 0–3 corresponding to experiencing cognitive difficulties “never” (0), “once a week or less” (1), “twice a week” (2), or “almost daily” (3). A total score can be extracted summing the ranges from 0 to 36. An average frequency score can be computed dividing the total score by 12. The MIC-SR has proven reliability and validity in patients with schizophrenia99.

Performance-based cognitive performance

Performance-based cognition was indexed with the Brief Assessment of Cognition in Schizophrenia (BACS) battery10. The BACS composite score derives from six subtests of the domains of verbal learning and memory, speed of processing and executive functions.

Clinical symptoms and functioning

Symptoms were assessed with three instruments; the CAARMS, providing a level of attenuated psychotic symptom, by weighing the intensity of symptom scores by their frequency to form a CAARMS composite score13; the Scale for the Assessment of Negative Symptoms (SANS) yielding the level of negative symptoms using the SANS global score; and the Montgomery-Åsberg Depression Rating Scale (MADRS)14 yielding level of depressive symptoms. Functioning was measured with two instruments capturing different aspects of functioning: Overall functioning was measured using the Personal and Social Performance Scale (PSP)15.

This is a composite measure of functioning in the areas of occupational functioning, social functioning, and self-care. Subjective quality of life was reported with the Assessment of Quality of Life (AQoL-8D)56. The clinical assessors were all psychologists and medical doctors, that had received extensive training in using the instruments and conducted regular inter-rater reliability ratings on selected outcomes. Cognitive tests were conducted by psychologist students that had received comprehensive training and were supervised regularly by a senior psychologist.

Statistical analysis

Analyses were performed using SPSS version 25.0. Baseline descriptive statistics were reported by means and standard deviations. One-way analyses of variance (ANOVA) was used to compare the group displaying performance-based cognitive deficits with the group that did not on the MIC-SR. Stratification of the sample was based on whether or not the participants displayed a BACS composite score of 8–13.5, as previous findings indicate this to be a relevant cut-off to determine borderline to impaired cognition12. Univariate linear regression analyses were run to investigate the association between the dependent variable of MIC-SR and the independent variables of clinical symptoms (CAARMS, SANS, MADRS) and functioning (PSP and AQoL-8D). Bivariate correlations, using a Spearman’s correlation coefficient with a two-tailed significance test, were run to investigate the correlations between MIC-SR total score and BACS composite score at baseline and as difference score pre/post-treatment along with indices of adherence to the cognitive remediation intervention. Significance levels were set to p < 0.05.

Reporting summary

Further information on experimental design is available in the Nature Research Reporting Summary linked to this paper.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ADDITIONAL INFORMATION

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