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Social cognitive functioning in prodromal psychosis: A meta-analysis

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ABSTRACT

Background: There is substantial evidence regarding a social cognitive deficit in schizophrenia, and it has been suggested to be a trait-marker of this disorder. However, a domain-by-domain analysis of social cognitive deficits in individuals at clinical high risk (CHR) for psychosis has not been performed.

Method: Electronic databases were searched for studies regarding social cognitive performance in individuals at CHR. The included social cognitive domains, which were classified based on the Social Cognition Psychometric Evaluation (SCOPE) initiative of the National Institute of Mental Health (NIMH), were as follows: theory of mind (ToM), social perception (SP), attributional bias (AB), and emotion processing (EP).

Results: Twenty studies that included 1229 individuals at CHR and 825 healthy controls met the inclusion criteria. The overall effect size for social cognition was medium ($g = -0.477$). The largest effect size was identified for AB ($g = -0.708$). A medium effect size was identified for EP ($g = -0.446$) and ToM ($g = -0.425$), and small effects were identified for SP ($g = -0.383$).

Conclusion: This is the first quantitative domain-by-domain social cognitive meta-analysis regarding CHR individuals. The present study indicated that individuals at CHR exhibited significant impairments in all domains of social cognition compared with healthy controls, with the largest effect size identified for AB. The identification of social cognitive domains that reflect an increased risk for impending psychosis and of predictors of the conversion to psychosis via a longitudinal follow-up study is required.

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1. Introduction

Social cognition refers to the mental operations that underlie social interactions, including the processes involved in the perception, interpretation, and generation of responses to the intentions, dispositions, and behaviors of other individuals (Penn et al., 1997; Green et al., 2005). Social cognition, similar to other aspects of cognition, is a multi-faceted concept that comprises several sub-domains and processes. The Social Cognition Psychometric Evaluation (SCOPE) initiative of the National Institute of Mental Health (NIMH) identified four relevant domains, namely, theory of mind (ToM), social perception (SP), attributional bias (AB), and emotion processing (EP) (Green et al., 2004, 2008; Pinkham et al., 2014). Recent meta-analyses have indicated that social cognitive function in patients with schizophrenia was markedly impaired (Savla et al., 2013; Chung et al., 2014). Deficits in social cognition are associated with the functional outcome of schizophrenia and contribute to the functional outcome beyond neurocognition (Schmidt

et al., 2011; Mehta et al., 2013a). Social cognitive deficits are relatively stable throughout the disease course (Addington et al., 2006; Horan et al., 2012) given that these deficits are observed during remission (Sprong et al., 2007; Mehta et al., 2013b), as well as in relatives (Lavoie et al., 2013). These findings suggest that social cognitive deficits represent a trait marker for schizophrenia that is related to a genetic vulnerability associated with the pathology rather than a state-related aspect; however, some inconsistencies exist in each domain (Fiszdon and Reddy, 2012; Pinkham, 2014).

The concepts of 'clinical high risk' (CHR) and 'ultra-high risk' have been developed over the previous two decades to identify subjects at imminent risk of psychosis (Miller et al., 2002; McGorry et al., 2003; Fusar-Poli et al., 2013). Similarly, the concept of 'Basic Symptom', which is considered to be an earlier state of psychosis, has also been developed complementary to and along with high risk concepts (Schultze-Lutter et al., 2012). The high-risk state for psychosis is also associated with significant and widespread impairments in social cognition and neurocognitive performances (Fusar-Poli et al., 2012a; Bora and Murray, 2014; Lee et al., 2014a). A recent study demonstrated that ToM was impaired in individuals at CHR, and the performance of this group was intermediate between patients with first-episode psychosis and healthy controls (Bora and Pantelis, 2013). Individuals at CHR who later developed psychosis performed worse in the ToM domain

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compared with those who did not transition to psychosis (Kim et al., 2011). These results suggest that the ToM performance in individuals at CHR is intermediate between those of the healthy population and patients with schizophrenia. Patients with schizophrenia consistently exhibit deficits in SP (Green et al., 2007; Couture et al., 2010), and EP (Gur et al., 2002; Fisher et al., 2008); however, individuals at CHR exhibit mixed findings regarding social cognitive deficits (Pinkham et al., 2007; Couture et al., 2008; Pauly et al., 2010; Devylder et al., 2013). Therefore, the domains of social cognition that are associated with the largest impairments in individuals at CHR are not clear. Savla et al. (2013) found no significant differences in AB in patients with schizophrenia compared with healthy controls but did demonstrate that performances in other domains were impaired in patients with schizophrenia. However, most studies in individuals at CHR exhibit higher AB compared with healthy controls (An et al., 2010; Hauser et al., 2011; Stowkowy and Addington, 2012; Thompson et al., 2013). These findings suggest that an abnormality of AB in CHR is the specific feature that distinguishes it from schizophrenia.

Previous meta-analyses only investigated a single domain or social cognition as a whole (Fusar-Poli et al., 2012a; Bora and Pantelis, 2013). However, a domain-by-domain quantitative analysis of social cognitive function in individuals at CHR has not been performed. The identification of the domains and the extent of social deficits in individuals at CHR will aid in the determination of specific impairments that are trait markers for schizophrenia, indicate an increased or decreased risk of the transition to psychosis, and identify more specific targets in the development of therapeutic regimens for the high-risk group. The goals of the current meta-analysis are (1) to examine the magnitude of the differences between individuals at CHR and healthy controls across all four domains of social cognition, (2) to evaluate the impact of different moderators on the performance of each domain, and (3) to determine if significant impairments in each component of social cognition are present in CHR individuals who later develop psychosis compared with CHR non-converters.

2. Methods

2.1. Literature search

A systematic search strategy identified relevant studies. Two independent researchers (T. Y. L. and S. B. H.) conducted a two-step literature search. First, a literature search using PubMed, PsycINFO, EMBASE, and CINAHLplus was performed to identify relevant articles from database inception to November 2014. The following keywords, including their synonyms and combinations, were used as search terms: “social cognition”, “theory of mind”, “mentalizing”, “emotional perception”, “emotional processing”, “social perception”, “attributional bias”, “at-risk mental state”, “clinical high risk”, “ultra high risk”, “early psychosis” and “prodromal psychosis”. In a second step, the reference lists of the published reviews and studies were manually checked to identify additional relevant publications.

2.2. Inclusion and exclusion criteria

Studies were included if they met the following criteria: (1) articles written in English; (2) original articles in peer-reviewed journals; (3) the subjects of the studies included a) a CHR group on the basis of the Structured Interview for Prodromal Syndromes (SIPS), the Comprehensive Assessment of At-Risk Mental States (CAARMS), the Bonn Scale for the Assessment of Basic Symptoms (BSABS), or the Schizophrenia Proneness Instrument, Adult version (SPI-A) or Child and Youth version (SPI-CY) and b) a healthy control group; (4) studies reported measures of social cognition that fell into one of four domains (ToM, SP, AB, and EP); and (5) studies reported sufficient data to enable calculation of the effect size and standard error or provided such data when

contacted. In cases of sample overlap, the study with the largest sample size was included. The authors were contacted to provide additional information when necessary.

2.3. Social cognitive domains

The recent SCOPE study identified four domains of social cognition in individuals at CHR (Pinkham et al., 2014).

- (1) *ToM*
This domain reflects the ability to represent the mental states of oneself and other individuals and understand that other individuals have beliefs, desires, and intentions that are different from one's own.
- (2) *SP*
SP reflects the ability to match expressive behavior with prototypical social situations and/or make social judgments that extend beyond an understanding or prediction of other individuals' mental states.
- (3) *AB*
AB refers to a cognitive bias of misinterpretations when individuals evaluate and/or attempt to identify reasons for their own and other individuals' behaviors, social events and interactions.
- (4) *EP*
EP refers to the perception and recognition of one's own and other individuals' emotional states using specific characteristics of facial, bodily, and verbal expressions.

2.4. Statistical analysis

The data were entered into an electronic database and analyzed using a quantitative meta-analytic approach in Stata version 13 (StataCorp, TX, US). The primary outcome measures were the means and standard deviations of the test performances of the individuals at CHR compared with the healthy controls. The effect sizes that used a random-effects model for each domain and an overall effect size for all studies were calculated as Hedges' g , which corrects for the bias that can result from studies with small sample sizes; negative values indicate worse performances in CHR individuals compared with healthy controls and in CHR converters compared with CHR non-converters. To assess the potential effects of publication bias, funnel plots were used, and the trim-and-fill procedure was generated (Duval and Tweedie, 2000). Meta-regression analyses assessed the modulating effects of age, gender, education year, and intelligence quotient (IQ). Heterogeneity was assessed using Higgin's I^2 , with $I^2 > 50\%$ judged as significant heterogeneity not attributable to random error, in accordance with the recommendations for psychometric data (Higgins and Thompson, 2002).

3. Results

3.1. Description of studies

The electronic database and manual searches yielded 317 studies, and 22 studies were included in the meta-analysis (see Fig. 1 for the flowchart). Some studies were excluded because they shared the same subjects (Seiferth et al., 2008; van Rijn et al., 2011a; Amminger et al., 2012) or shared some subjects and had a smaller sample size (Chung et al., 2008; Kim et al., 2011). The 22 included studies reported data for 1229 individuals at CHR and 825 healthy controls. Three studies reported data regarding 31 converters and 112 non-converters among 143 individuals at CHR (Kim et al., 2011; Devylder et al., 2013; Gill et al., 2014). The criteria for the selection of the potential studies for the meta-analysis were tested using an inter-rater reliability check, which exhibited good agreement between two independent raters ($\kappa = 0.85$). Eight of the 22 studies reported ToM measurements, 3 studies reported

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