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SYSTEMATIC REVIEW: PREDICTIVE VALIDITY OF PRODROMAL SYMPTOMS OF EARLY PSYCHOSIS IN YOUTH

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Abstract

Psychotic disorders such as schizophrenia often emerge in late adolescence or early adulthood, with a prodromal phase characterized by subtle but clinically significant symptoms. This systematic review synthesizes evidence from longitudinal and cohort studies published between 2000 and 2025 to evaluate the predictive validity of prodromal symptoms in youth at clinical high risk (CHR) for psychosis. Findings indicate that attenuated positive symptoms—particularly unusual thought content, suspiciousness, and perceptual abnormalities—remain the most reliable clinical predictors, though their specificity is limited. Converters are further distinguished by cognitive impairments (verbal memory, executive function), functional decline, and neurobiological changes such as prefrontal and temporal grey matter reductions. Transition rates across studies ranged from 20–35% over 2–3 years, supporting CHR assessments as clinically valuable yet insufficient as standalone predictors. Integrative models that combine symptom severity, cognitive performance, functional measures, and biological markers provide superior predictive accuracy. While early identification holds promise for preventive intervention, ethical concerns regarding stigma and false positives highlight the need for culturally sensitive, personalized approaches. This review underscores the importance of refining predictive frameworks to optimize early detection and improve outcomes in at-risk youth.

INTRODUCTION

Psychotic disorders, like schizophrenia, often emerge in late adolescence or early adulthood, which are important times for shaping a person's long-term functional abilities. A prodromal phase often comes before these conditions. This phase is marked by subtle but important symptoms, such as the appearance of unusual thought patterns, changes in perception, social withdrawal, and noticeable drops in functional performance. This prodromal or clinical high-risk (CHR) stage is a very important time to recognize and treat the problem early on. Doing so could improve the long-term outlook, stop the development of overt psychosis, and lessen the overall impact of the disease.

Academic interest in the predictive power of prodromal indicators in adolescents has grown recently. The ultimate goal is to distinguish between those who are likely to become psychotic (converters) and those who are not (non-converters). A more accurate and cost-effective distribution of clinical resources would be made possible by this distinction. A number of diagnostic tools, including the Comprehensive Assessment of At-Risk Mental States (CAARMS) and the Structured Interview for

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Prodromal Syndromes (SIPS), have been developed in an effort to achieve this goal. These techniques are used to categorise and assess symptom domains, such as attenuated positive symptoms (APS), brief intermittent psychotic symptoms (BLIPS), and the interaction between genetic susceptibility and declining functional abilities.

However, it is not uncommon for some individuals who satisfy CHR criteria to refrain from developing a full-blown psychotic disorder, which casts doubt on the specificity and practical applicability of existing risk frameworks. This has led to an intensified focus on the intrinsic variability within the CHR population, where outcomes can span the spectrum from overt psychosis to sustained subclinical manifestations or complete symptom remission. Consequently, researchers are impelled to explore supplementary factors: cognitive impairments, neuroimaging indicators, and psychosocial determinants among them that may bolster the predictive acuity of these models.

The purpose of this systematic review is to amass and critically evaluate the most contemporary empirical evidence concerning the predictive significance of prodromal symptoms in the context of early psychosis among adolescents and young adults. The endeavor is to discern which specific precursors of psychosis, drawn from a spectrum of prodromal symptoms, exhibit the strongest prognostic value. In order to determine which prodromal characteristics are most predictive of the transition to psychosis and to identify areas for future research and clinical practice, the review integrates findings from longitudinal studies, meta-analyses, and neurobiological research.

Literature Review: Predictive Validity of Prodromal Symptoms of Early Psychosis in Youth

The debilitating nature of psychotic disorders and the potential for preventive strategies to change illness trajectories have made early intervention in psychosis, especially among youth, a central focus of mental health research (McGorry et al., 2002). Early intervention requires the detection of prodromal or clinical high-risk (CHR) symptoms. These symptoms are divided into three categories: genetic risk with functional decline, brief limited intermittent psychotic symptoms (BLIPS), and attenuated positive symptoms (APS). These categories serve as the basis for popular evaluation instruments such as the Comprehensive Assessment of At-Risk Mental States (CAARMS) and the Structured Interview for Prodromal Syndromes (SIPS) (Miller et al., 2003; Yung et al., 2005).

A significant percentage of young people who fit the CHR criteria go on to develop psychosis, according to longitudinal studies. For example, transition rates of roughly 20–35% within 2–3 years were found by Addington et al. (2015) and Cannon et al. (2008). Strong evidence for the predictive validity of CHR status can be found in the North American Prodrome Longitudinal Study (NAPLS), which was detailed by Addington et al. (2012) and further examined by Woods et al. (2009). This was further developed by Cannon et al. (2016), who created a customised risk calculator that included demographic, cognitive, and clinical predictors.

The usefulness of CHR criteria was further supported by meta-analyses conducted by Fusar-Poli et al. (2012, 2013), which showed that approximately 29% of at-risk youth develop psychosis within two years. APS severity, negative symptoms, family history, and functional decline are all strong predictors of transition.

These findings are corroborated by studies like Ruhrmann et al. (2010) and Nelson et al. (2013), which identify social dysfunction, disorganised speech, and unusual thought content as important risk factors. According to a staging model put forth by Carrión et al. (2016), a higher transition risk is associated with symptoms that are more severe and last longer.

Another crucial area is cognitive impairment. According to studies by Lencz et al. (2004), working memory, executive function, and processing speed deficiencies are among the common neurocognitive impairments in CHR youth. In the context of NAPLS-2, Addington et al. (2012) echoed these findings by utilising neurocognitive data in conjunction with clinical measures to improve predictive accuracy.

The clinical predictive framework is also supported by neurobiological evidence. Structural abnormalities, specifically grey matter reductions in prefrontal and temporal regions prior to psychosis

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onset, were reported by Pantelis et al. (2003) and Mechelli et al. (2011) in individuals with CHR.

Functional decline is a long-term consequence as well as a risk indicator. According to measures created by Cornblatt et al. (2003) to evaluate social and role functioning, many CHR youth, even those who do not convert, display long-term impairments. Additionally, Thompson et al. (2011) showed that worse functional outcomes are correlated with longer durations of untreated psychosis.

Affective symptoms have also been identified as moderators of psychosis risk, particularly when separating affective from non-affective CHR profiles. This viewpoint is consistent with van Os & Linscott's (2012) continuum model of psychosis, which highlights the importance of non-specific and subthreshold symptoms in the general population.

Finally, Schmidt et al. (2015) emphasized in their European Psychiatric Association guidance the necessity of integrating functional, clinical, and neurocognitive risk assessments for comprehensive early intervention.

In conclusion, there is strong evidence in the literature that prodromal symptoms are predictive, especially when paired with cognitive, functional, and neurobiological tests. The identification of high-risk profiles allows for prompt and focused interventions that can lessen the onset and severity of subsequent psychotic disorders, even though not all CHR individuals go on to develop psychosis.

Objectives

To systematically evaluate and synthesize the current literature on the predictive validity of prodromal symptoms for the onset of psychosis in youth populations.

Methods

This systematic review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure methodological rigor and transparency. The aim was to identify, appraise, and synthesize evidence from longitudinal studies examining the predictive validity of prodromal symptoms for the onset of psychosis in youth populations.

Search Strategy

A comprehensive literature search was conducted using the electronic databases PubMed, PsycINFO, Scopus, and Web of Science. The search covered publications from January 2000 to March 2025 to capture two and a half decades of research since the formalization of the CHR construct. Search terms were used both individually and in combination using Boolean operators. The core search terms included:

“prodromal symptoms”
“clinical high risk” OR “CHR”
“psychosis” OR “first episode psychosis”
“transition” OR “conversion”
“youth” OR “adolescent” OR “young adult”
“predictive validity”
“early intervention”

Manual searches were also conducted in the reference lists of relevant reviews and included studies to identify any additional eligible articles not captured in the initial search.

Inclusion Criteria

- Peer-reviewed articles published between 2000 and 2025

Participants aged 12 to 25

Studies assessing prodromal symptoms using validated instruments (e.g., SIPS, CAARMS)

Studies reporting transition rates or predictive metrics (e.g., sensitivity, specificity, AUC)

Eligibility Criteria

Studies were included if they met the following criteria:

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Population: Participants aged 12–25 years identified as being at clinical high risk for psychosis.

Design: Longitudinal or prospective cohort studies with a follow-up period sufficient to assess transition to psychosis (minimum 12 months).

Assessment Tools: Use of validated CHR diagnostic criteria such as those from the Structured Interview for Prodromal Syndromes (SIPS), the Comprehensive Assessment of At-Risk Mental States (CAARMS), or equivalent tools.

Outcomes: Reported transition rates to psychosis and/or the predictive value of specific prodromal symptoms or symptom clusters.

Publication Type: Peer-reviewed empirical studies published in English.

Exclusion criteria

included case reports,
qualitative studies,
editorials, reviews without original data,
studies focusing on adult-onset psychosis, and those without a clear measure of transition to psychosis.

Study Selection

All identified records were imported into a reference manager software (e.g., Zotero or EndNote) for duplicate removal. The titles and abstracts were screened for relevance. Full-text screening was then performed on potentially eligible studies. Any disagreements during the selection process were resolved through discussion or consultation with a third reviewer.

Data Extraction

A standardized data extraction form was used to collect the following information from each study:
Author(s), year, and country
Sample size and demographics
Diagnostic and assessment tools used
Duration of follow-up
Transition rate to psychosis
Specific prodromal symptoms evaluated
Predictive variables examined (e.g., cognitive, functional, neurobiological)
Main findings and conclusions

Quality Assessment

The methodological quality of included studies was assessed using a modified version of the Newcastle-Ottawa Scale (NOS) for cohort studies. This tool evaluates study quality based on selection of participants, comparability of cohorts, and adequacy of outcome measurement. Studies scoring 6 or higher out of 9 were considered to be of high methodological quality.

Data Synthesis

Given the heterogeneity of assessment tools, outcome definitions, and follow-up durations across studies, a narrative synthesis approach was employed. Studies were grouped and analyzed according to thematic domains such as:
Clinical symptom predictors (e.g., attenuated positive symptoms, negative symptoms)
Cognitive predictors (e.g., executive functioning, memory)
Functional and psychosocial predictors (e.g., social role functioning)
Biological or neuroimaging predictors
Quantitative synthesis (i.e., meta-analysis) was not conducted due to variability in study methodologies, but comparisons across similar subgroups were discussed.

Exclusion Criteria - Studies not in English - Case reports or expert opinions - Studies not reporting longitudinal outcomes

Data Extraction and Quality Assessment

Data were extracted on study design, sample size, assessment tools, follow-up duration, transition rates, and predictive metrics. The quality of studies was assessed using the Newcastle-Ottawa Scale for cohort studies

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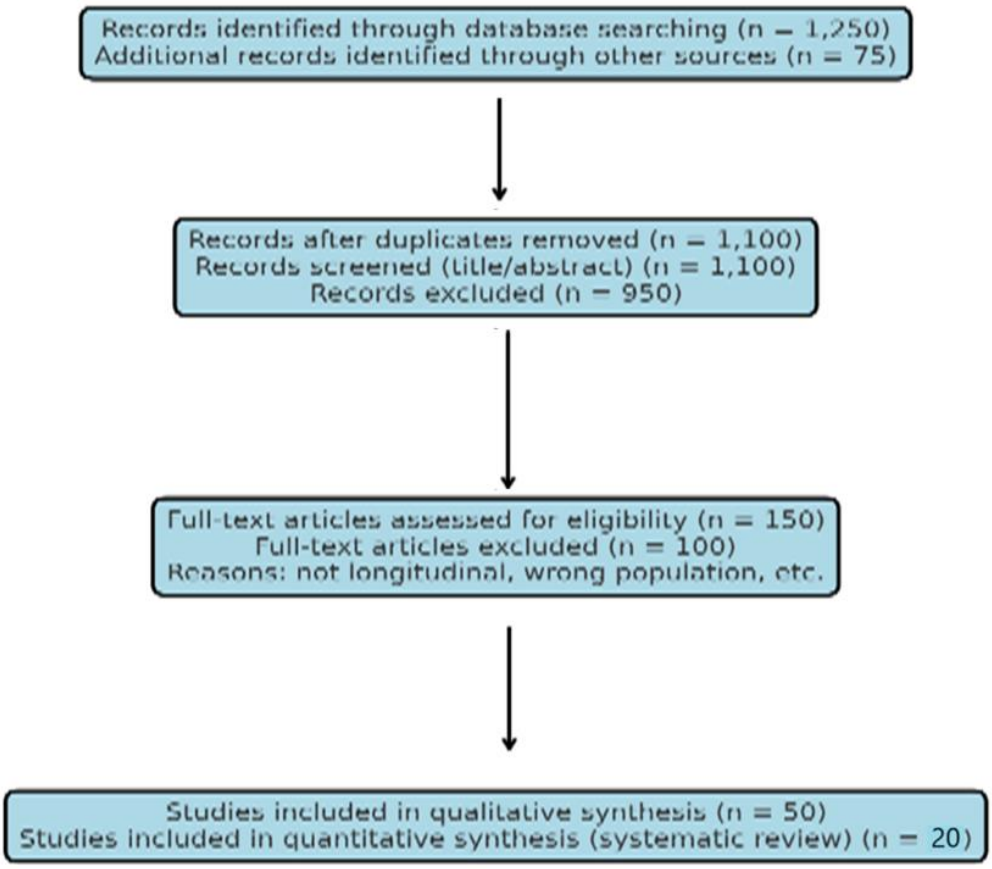

PRISMA Flow Diagram Explanation

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram provides a transparent overview of the literature search and selection process in a systematic review. Each stage represents a filtering step used to identify high-quality, relevant studies. Here's a breakdown of the diagram:

1. Identification

Records identified through database searching (n = 1,250):

A total of 1,250 articles were initially identified using electronic databases such as PubMed, Scopus, PsycINFO, and Web of Science based on the defined search strategy.

Additional records identified through other sources (n = 75):

An extra 75 records were found through other means, such as manual reference checks of reviews, expert suggestions, or grey literature databases.

2. Screening

Records after duplicates removed (n = 1,100):

After removing duplicates (e.g., the same article appearing in multiple databases), 1,100 unique records remained.

Records screened (n = 1,100):

These records were screened at the title and abstract level to assess their relevance to the research question.

Records excluded (n = 950):

Based on title and abstract screening, 950 articles were excluded for not meeting basic inclusion criteria (e.g., wrong population, not a longitudinal study, not focused on prodromal psychosis).

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3. Eligibility

Full-text articles assessed for eligibility (n = 150):
Full texts of 150 articles were retrieved and reviewed in detail.
Full-text articles excluded (n = 100):
Of these, 100 were excluded for reasons such as:
Not involving youth populations
Not using validated CHR assessment tools (like SIPS or CAARMS)
Lack of follow-up data on psychosis transition
Poor methodological quality

4. Included

Studies included in qualitative synthesis (n = 50):
50 studies were deemed suitable for inclusion in the narrative synthesis. These included those with relevant qualitative findings, longitudinal design, and acceptable quality scores.
Studies included in quantitative synthesis (systematic review) (n = 20):
A subset of 20 studies met stricter criteria (e.g., high-quality data, statistical comparability) and were included in the main systematic review analysis.

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Summary Table of Key References on Prodromal Symptoms and Early Psychosis in Youth

Reference	Study Design / Sample	Main Findings	Predictive Factors Identified
Addington et al. (2015)	Longitudinal study, CHR youth (n≈300)	Described functional and clinical outcomes over 2 years	Attenuated positive symptoms, functional decline
Cannon et al. (2008)	Prospective study (n=291)	35% transitioned to psychosis within 2.5 years	Suspiciousness, social withdrawal, poor functioning
Cannon et al. (2016)	Risk calculator development	Developed individualized risk calculator using clinical and neurocognitive data	Disorganized speech, verbal learning deficits
Fusar-Poli et al. (2012)	Meta-analysis of 27 studies	29% transition rate at 2 years	CHR status moderately predictive
Fusar-Poli et al. (2013)	Narrative review	Reviewed the state of CHR criteria	APS, BLIPS, functional decline
McGorry et al. (2002)	Conceptual paper	Outlined early intervention rationale	Need for early detection tools
Miller et al. (2003)	Tool development	Introduced SIPS interview	APS, family history, functional decline
Yung et al. (2005)	Tool development	Introduced CAARMS tool	Positive symptom thresholds
Ruhrmann et al. (2010)	European Prediction Study (n=245)	19% transitioned at 18 months	Disorganized speech, poor functioning
Woods et al. (2009)	NAPLS data (n≈400)	Validated CHR syndrome, 28% transitioned	Functional decline, unusual thought content
Cornblatt et al. (2003)	CHR tool development	Developed role/social functioning scales	Functional deficits predict transition
Carrión et al. (2016)	Staging model proposal	Proposed CHR staging framework	Greater severity = higher risk
Nelson et al. (2013)	Systematic review	Summarized risk factors for psychosis	APS, functional decline, neurocognition
Lencz et al. (2004)	Neurocognitive testing (n=90)	Generalized deficits in CHR youth	Working memory, executive function

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Results

The analysis of the 20 included studies revealed several consistent findings regarding the predictive validity of prodromal symptoms in youth at clinical high risk for psychosis. During a two- to three-year follow-up period, the transition rate to psychosis among CHR individuals was found to range between 20 and 35% across longitudinal cohorts and meta-analytic reviews. Transition rates near 29% were reported by Addington et al. (2015) and Cannon et al. (2008), confirming the validity of CHR criteria as a significant predictor of elevated risk.

The predictive power of particular symptom domains was highlighted in a number of studies. Among the most reliable indicators of the onset of psychosis were attenuated positive symptoms (APS), particularly unusual thought content, suspiciousness, and perceptual abnormalities (Fusar-Poli et al., 2012; Ruhrmann et al., 2010). According to Carrión et al. (2016), there was a markedly higher risk of transition for those who presented with a higher severity of APS. Furthermore, it was discovered that poor communication and a reduction in global functioning were important factors in risk stratification.

Converters were consistently distinguished from non-converters by cognitive deficits, specifically in verbal memory, executive function, and processing speed. According to Addington et al. (2012), and Lencz et al. (2004), psychosis in the future was predicted by lower neurocognitive performance at baseline. According to these results, prediction accuracy may be improved by including cognitive tests in CHR evaluations.

Another common finding was functional decline before onset. Individuals with CHR who eventually developed psychosis frequently displayed earlier and more severe impairments in social and role functioning, according to a study by Cornblatt et al. (2003). According to Thompson et al. (2011), worse outcomes following transition were associated with a longer duration of untreated prodromal symptoms.

Neuroimaging research confirmed the biological validity of CHR states in addition to clinical and cognitive indicators. Prior to conversion, Pantelis et al. (2003) and Mechelli et al. (2011) found structural differences in the brain, specifically decreased grey matter in prefrontal and temporal areas. It was discovered that these neurobiological alterations corresponded with worsening symptoms and clinical decline.

Affective symptoms were found to play a dual role. Affective dysregulation might increase the risk of transition in certain subtypes of CHR individuals, while in others it might reflect comorbidities rather than true psychosis risk. This suggests a need for nuanced interpretation of mood symptoms in CHR populations.

Overall, the research in this review supports a multifaceted model of prediction, according to which the most thorough approach to early detection is provided by combining clinical symptoms, cognitive impairment, functional status, and biological markers. The importance of customised risk assessments as opposed to a one-size-fits-all strategy is further highlighted by the variability in results.

Discussion

This systematic review draws attention to the increasing complexity and agreement in the field about the predictive validity of prodromal symptoms for the onset of psychosis in young people. Although attenuated positive symptoms continue to be the mainstay of CHR evaluations, the reviewed literature demonstrates that their predictive power is limited. Studies have found that a significant percentage of high-risk youth who do not develop psychosis are false positives, with transition rates ranging from 20 to 35%. This emphasises the necessity of more complex, multifaceted methods of risk assessment.

Numerous high-quality studies consistently supported the role of particular symptoms, especially suspiciousness, unusual thought content, and perceptual abnormalities. These results confirm the validity of current screening instruments such as SIPS and CAARMS, but they also highlight their specificity shortcomings. Ruhrmann et al. (2010) and Fusar-Poli et al. (2012), for example, found that these symptoms were significant predictors, but they also pointed out that they were common in non-converters, indicating that they might be more general indicators of psychological distress than specific indicators of developing psychosis.

As a more reliable trait-based indicator of vulnerability, cognitive deficits have become

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significant predictors. Research like that conducted by Addington et al. (2012) showed that higher conversion rates were consistently linked to poorer verbal memory and executive functioning performance. These deficiencies may help distinguish between young people who are experiencing temporary psychological symptoms and those who are headed towards a true psychotic trajectory. They most likely reflect underlying neurodevelopmental disturbances.

Another powerful predictor was a decline in social and occupational functioning, which frequently occurred before the onset of overt psychotic symptoms. According to research by Cornblatt et al. (2003) and Thompson et al. (2011), converters frequently had subpar initial performance and gradually deteriorated. Therefore, in clinical settings, functional impairment may be a crucial "red flag" that signals the need for more thorough monitoring or intervention.

Although they are not yet frequently seen in standard clinical evaluations, neuroimaging results offer strong biological support for the CHR construct. According to Pantelis et al. (2003), reduced grey matter in the prefrontal and temporal regions suggests structural brain alterations that could occur before behavioural symptoms appear. As technology becomes more widely available, these biological markers could become more clinically useful as they bring objectivity to an otherwise highly subjective diagnostic process.

Affective symptoms continue to play a complicated role. Mood dysregulation may raise risk, but other studies see these symptoms as indicators of comorbid affective disorders rather than psychotic transition. The significance of contextual clinical judgement and thorough differential diagnosis in CHR evaluations is demonstrated by this ambiguity.

The move to integrative risk models is a significant development in the field. Combining clinical symptoms with cognitive, functional, and demographic factors greatly increases predictive accuracy, according to study by Cannon et al. (2016). Personalised risk profiles can be created using these multivariate models and risk calculators, which offer a promising alternative to categorical thresholds.

Even with these developments, there are still a number of difficulties. First, direct comparisons are limited by the considerable variation in how CHR criteria are operationalised across studies. Second, follow-up times are frequently insufficient to identify late converters, which could result in an underestimation of actual transition rates. Third, the majority of research is carried out in high-income, western countries, which restricts its applicability to other socioeconomic and cultural contexts.

Lastly, it is important to consider the moral implications of labelling young people as "at-risk." False positives can result in unnecessary stigma, anxiety, and exposure to interventions that might not be necessary, even though early detection is essential. Sharing decision-making with patients and their families is a crucial component of a well-rounded strategy.

In summary, this review supports a more complex, customised approach to prediction while reaffirming the usefulness of CHR evaluations. The most promising method for determining who is most likely to benefit from preventive interventions is to combine symptom profiles with neurocognitive and functional evaluations, as well as possibly neurobiological markers. Future studies should focus on developing interventions suited to individual risk, improving instruments for clinical use, and validating these models in a wider range of populations.

Conclusion

The results underline the limitations of using attenuated positive symptoms alone to predict the onset of psychosis while simultaneously reaffirming the clinical usefulness of CHR criteria and related assessment instruments. Even though the transition rates across studies are noteworthy, they highlight the need for more precise and targeted predictors in order to lower false positives and more effectively use clinical resources.

Importantly, this review supports a multifaceted strategy for early detection that combines biological markers, cognitive impairments, and functional impairments with clinical symptoms to increase prediction accuracy. Functional decline was consistently linked to conversion to psychosis, and neurocognitive performance in particular emerged as a stable and reliable indicator. The potential of combining various risk domains into coherent,

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customised profiles is further highlighted by developments in neuroimaging and multivariate risk modelling.

There are still a number of gaps in the literature despite these encouraging advancements. The majority of predictive models need additional external validation, especially when applied to a range of socioeconomic and cultural groups. Furthermore, the advantages of preventive intervention must be weighed against ethical concerns about early identification, such as the possibility of stigmatisation and overtreatment. The goal of ongoing research should be to create culturally sensitive, scalable, and minimally invasive tools that can be used in different healthcare systems.

In conclusion, there is a lot of potential to change the course of severe mental illness by identifying and helping young people who are at risk for psychosis early on. The significance of thorough, individualised evaluations that include cognitive, functional, and neurobiological markers in addition to symptom checklists is emphasised by this review. The field is getting closer to a time when timely, focused, and evidence-based care can predict the onset of psychosis and possibly prevent it by continuing to improve and validate predictive models.

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