ORIGINAL ARTICLE

WILEY

Prevalence and predictors of suicidality and non-suicidal self-harm among individuals at clinical high-risk for psychosis: Results from a community-recruited sample

Kate Haining[1] | Olga Karagiorgou[1] | Ruchika Gajwani[2] | Joachim Gross[1] | Andrew I. Gumley[2] | Stephen M. Lawrie[3] | Matthias Schwannauer[4] | Frauke Schultze-Lutter[5,6,7] | Peter J. Uhlhaas[1,8]

[1]Institute of Neuroscience and Psychology, University of Glasgow, Scotland, UK

[2]Institute of Health and Wellbeing, University of Glasgow, Scotland, UK

[3]Department of Psychiatry, University of Edinburgh, Edinburgh, Scotland, UK

[4]Department of Clinical Psychology, University of Edinburgh, Edinburgh, Scotland, UK

[5]Department of Psychiatry and Psychotherapy, Medical Faculty, Heinrich Heine University, Düsseldorf, Germany

[6]Department of Psychology and Mental Health, Faculty of Psychology, Airlangga University, Surabaya, Indonesia

[7]University Hospital of Child and Adolescent Psychiatry and Psychotherapy, University of Bern, Bern, Switzerland

[8]Department of Child and Adolescent Psychiatry, Charité Universitätsmedizin, Berlin, Germany

Correspondence

Peter J. Uhlhaas, Department of Child and Adolescent Psychiatry, Charité Universitätsmedizin, Berlin, Germany.
Email: peter.uhlhaas@charit.de

Abstract

Aim: Suicidal thoughts and behaviours are prevalent in individuals with schizophrenia. However, research examining the prevalence and predictors of suicidality and self-harm in participants at clinical high-risk for psychosis (CHR-P) is limited and mostly focuses on help-seeking participants recruited through clinical pathways. The current study sought to assess the prevalence of suicidality and self-harm and identify predictors of current suicidal ideation in community-recruited CHR-P participants.

Methods: Data were available for 130 CHR-P participants, 15 participants with first-episode psychosis (FEP), 47 participants not fulfilling CHR-P criteria (CHR-Ns) and 53 healthy controls. Current and lifetime suicidality and self-harm were assessed using the Mini-International Neuropsychiatric Interview and the Comprehensive Assessment of At-Risk Mental States (CAARMS). Multivariable logistic regression analysis was used to determine predictors of current suicidal ideation in the CHR-P group.

Results: A considerable proportion of CHR-P participants disclosed current suicidal ideation (34.6%). Overall, FEP individuals were at greatest risk, with considerably high prevalence rates for current suicidal ideation (73.3%), lifetime self-harm behaviour (60.0%) and lifetime suicide attempt (60.0%). In the CHR-P sample, current suicidal ideation was predicted by lifetime suicide attempts, lower CAARMS severity, impaired social functioning and greater comorbidity.

Conclusions: Our findings suggest that suicidality and self-harm are highly prevalent in community-recruited CHR-P and FEP individuals. Accordingly, these results highlight the importance of further research into the determinants of suicidality and self-harm during at-risk and early stages of psychosis, and the implementation of intervention strategies to reduce adverse outcomes in these populations.

1 | INTRODUCTION

Psychotic disorders, such as schizophrenia, are strongly linked to high levels of suicidality. Compared to the general population, individuals with schizophrenia have a 13-fold greater risk of suicide (Too et al., 2019) and approximately 4.9% die by suicide (Palmer et al., 2005). Individuals with first-episode psychosis (FEP) comprise a particularly vulnerable group. Indeed, suicide risk is elevated by 60% within the first year of treatment relative to later stages (Nordentoft et al., 2004).

Research examining the prevalence of suicidality and self-harm in individuals at clinical high-risk for psychosis (CHR-P) is more limited albeit emerging (L. Pelizza et al., 2020; Taylor et al., 2015). CHR-P participants are characterised using ultra-high risk (UHR) criteria, which include attenuated psychotic symptoms, brief frank psychosis and functional decline with genetic risk (Yung et al., 2005), as well as basic symptom criteria relying on perceptual and cognitive disturbances self-experienced with full and immediate insight (F. Schultze-Lutter, 2009; F. Schultze-Lutter et al., 2012). Over a 2-year period, around 20% of individuals meeting UHR criteria transition to psychosis (P. Fusar-Poli, Cappucciati, et al., 2016). Moreover, in a UHR sample, approximately 45% of nonconverters experienced either poor social or role outcome (Carrión et al., 2013); impairments previously related to persistence of CHR-P symptoms (Michel et al., 2018).

A recent meta-analysis reported prevalence rates of 66% for current suicidal ideation, 18% for lifetime suicide attempts and 49% for lifetime self-harm behaviour in UHR samples, comparable to those observed in FEP cohorts (Taylor et al., 2015).Furthermore, in a retrospective study of prodromal suicide risk among individuals with schizophrenia, 25.5% had experienced suicidal ideation and 7.5% had attempted suicide (Andriopoulos et al., 2011). More recently, L. Pelizza et al. (2020) found that UHR individuals disclosed more severe suicidal ideation and were more likely to report previous suicide attempts than FEP and non-UHR/FEP samples. Therefore, there is a need to further identify the factors underlying the emergence of suicidality and self-harm in CHR-P populations.

However, relatively little is known about the predictors of suicidality and self-harm in CHP-P individuals. Paranoid thinking, depressive symptoms and impaired role functioning have been found to predict current suicidal ideation (Andriopoulos et al., 2011; Bang et al., 2017; L. Pelizza et al., 2019), while the presence of personality disorders and history of trauma strongly predict suicide attempts (Zuschlag et al., 2018), consistent with findings in established schizophrenia and other psychiatric populations (Aaltonen et al., 2016; Bornheimer, 2016; Fuller-Thomson & Hollister, 2016).Within these latter cohorts, suicidal ideation and previous suicide attempts have been identified as two of the strongest predictors of completed suicide (Fosse et al., 2017; Lopez-Morinigo et al., 2016) and future suicide attempts (Bertelsen et al., 2007; Horwitz et al., 2015).

To date, the majority of studies investigating suicidality and self-harm in CHR-P populations involve help-seeking participants recruited through clinical pathways by UHR criteria. Accordingly, it is unclear whether the prevalence rates and predictors of suicidality and self-harm identified in these studies generalise to more representative community samples as well as CHR-P individuals recruited using UHR and/or basic symptom criteria. This is an important question given that recruitment pathways have been shown to impact on transition rates in CHR-P samples. Indeed, pretest risk for psychosis, although enriched in help-seeking samples, appears to be lower in community-recruited samples, reducing the likelihood of subsequent transitions (P. Fusar-Poli, Schultze-Lutter, et al., 2016).

In the current study, we sought to assess the prevalence of suidicality and self-harm in community-recruited CHR-P and FEP participants. We also included participants who did not fulfil CHR-P criteria but were characterised by psychiatric comorbidities (CHR-Ns) as well as a group of healthy controls (HCs). In addition, we aimed to identify predictors of current suicidal ideation in the CHR-P group. Social support, insecure attachment orientations and cognitive ability were also investigated given their relation with suicidality in the general population (E.M. Kleiman & Liu, 2013; Kosidou et al., 2014; Sörberg et al., 2013; Zortea et al., 2019).

Given these findings, we hypothesised that (1) CHR-P and FEP participants would show comparably higher levels of suicidality and self-harm than CHR-N and HC participants and (2) a range of clinical, functional and cognitive variables would emerge as significant predictors of current suicidal ideation in CHR-P participants.

2 | METHODS

2.1 | Participants

Participants were recruited as part of the Youth Mental Health Risk and Resilience (YouR) study(Uhlhaas et al., 2017), an ongoing longitudinal study funded by the Medical Research Council which aims to identify neurobiological and psychological mechanisms and predictors of psychosis risk. Utilising an online-screening approach (McDonald et al., 2019), potential CHR-P participants from the general population were directed to our website (www.yourstudy.org.uk) via email invitations, posters and flyers over a 4-year period. FEP and CHR-N participants were also recruited using this approach while HCs were obtained from an existing volunteer database. Screening questionnaires comprised (a) the 16-item Prodromal Questionnaire (PQ-16; Ising et al., 2012) and (b) a nine-item scale of Perceptual and Cognitive Anomalies (PCA) for assessing basic symptoms. Participants were invited for clinical interviews if they positively endorsed six or more items on the PQ-16 and/or three or more items on the PCA.

Data were available for 130 CHR-P individuals that were recruited across two sites: Glasgow (*n* = 94; 72.3%) and Edinburgh (*n* = 36; 27.7%).We also obtained a community-recruited sample of 15 FEP participants, 47 CHR-N participants and 53 HCs.

2.2 | Instruments and measures

In order to establish CHR-P criteria, the positive scale of the Comprehensive Assessment of At-Risk Mental States (CAARMS; Yung et al., 2005) and the Cognitive Disturbances (COGDIS) and Cognitive-Perceptive Basic Symptoms (COPER) items of the Schizophrenia Proneness Instrument, Adult version (SPI-A; F. Schultze-Lutter et al., 2007) were administered by trained research assistants and MSc/PhD level researchers. Participants were recruited into the CHR-P group if they met SPI-A COGDIS/COPERcriteria and/or one of the following CAARMS criteria: attenuated psychotic symptoms (APS), genetic risk and functional deterioration (GRFD) or brief limited intermittent psychotic symptoms. FEP criteria were established using the Positive and Negative Syndrome Scale (Kay et al., 1987) as well as the Structured Clinical Interview for DSM-IV (SCID; First et al., 2002).

Current (past month) and lifetime suicidality and self-harm were assessed using the six-item suicidality module of the Mini-International Neuropsychiatric Interview (MINI; Sheehan et al., 1998) as well as questions contained in the CAARMS suicidality and self-harm subscale. For FEP participants, only the latter assessment of suicidality and self-harm was available.

In addition, with the exception of the FEP group, all participants were assessed with the Global Functioning: Social (GF: Social) and Role (GF: Role) scales (Cornblatt et al., 2007), Premorbid Adjustment Scale (Cannon-Spoor et al., 1982), Adverse Childhood Experiences Scale (Felitti et al., 1998), Psychosis Attachment Measure (Berry et al., 2006), Significant Others Scale (Power et al., 1988)and Brief Assessment of Cognition in Schizophrenia (BACS; Keefe et al., 2004). Psychiatric comorbidity was calculated from the MINI by summing the number of current comorbid Axis I disorders disclosed by participants from a possible total of five (mood disorder, anxiety disorder, drug abuse/dependence, alcohol abuse/dependence, eating disorder).

2.3 | Statistical methods

Data were analysed using SPSS version 26 with statistical significance set at $p < .05$ (two-tailed). The BACS composite score was calculated by averaging the z-scores obtained from the six primary measures and re-standardizing this value using the means and standard deviations of sex-specific HCs (Keefe et al., 2004). Overall, 1.2% of the data (48 of 4,030 values) were missing and imputed by Bayesian imputation.

Group differences were analysed using non-parametric Kruskal–Wallis *H* tests and chi-square tests followed by appropriate Bonferroni-corrected post hoc tests if required. Collinearity of

predictors was defined as any variance inflation factor (VIF) > 2 and tolerance <0.40. Multivariable logistic regression analysis, using stepwise backward selection (likelihood ratio), was employed to determine predictors of current suicidal ideation in the CHR-P group. This outcome variable was prioritised as it did not violate the events per variable rule of 5:1 suggested by Vittinghoff and McCulloch (2007). The overall variance explained by the model was measured by the Nagelkerke pseudo R^2 statistic (R^2N). Diagnostic accuracy of the model was determined using the area under the receiver-operating characteristic curve (AUC).

3 | RESULTS

3.1 | Demographic data

CHR-P individuals were significantly impaired relative to CHR-N and HC participants, displaying greater CAARMS and SPI-A severity, higher comorbidity, lower social and role functioning and greater levels of insecure attachment (Table 1). As expected, FEP participants had significantly higher CAARMS severity compared to all other groups and greater antipsychotic use compared to CHR-P participants. Although significant group differences emerged for age, these effects did not survive Bonferroni-corrected post hoc tests.

A significantly larger proportion of FEP and CHR-P participants received current or past treatment compared to HCs (Table 1). Twenty percent of FEP participants and 16.2% of CHR-P participants were in current treatment while 60.0% of FEP participants and 45.4% of CHR-P participants received past treatment. CHR-N participants (31.9%) were also significantly more likely than HCs (5.7%) to have engaged in past treatment.

In addition, among the CHR-P group, 39 (30.0%) met CAARMS criteria, 32 (24.6%) met SPI-A criteria and 59 (45.4%) met both. Of those meeting CAARMS, 95.9% met APS criteria, 2.0% met GRFD criteria and 2.0% met both APS and GRFD criteria; while, of those meeting SPI-A criteria, 46.2% met COPER criteria, 14.3% met COGDIS criteria and 39.6% met both. Furthermore, the FEP group consisted of participants with SCID DSM-IV psychotic disorder not otherwise specified (n = 7; 46.7%), schizophrenia (n = 6; 40.0%) and schizoaffective disorder (n = 2; 13.3%).

3.2 | Suicidality and self-harm prevalence

Lifetime suicide attempts were significantly more prominent in individuals meeting CHR-P (29.2%) and FEP (60.0%) criteria compared to CHR-N (8.5%) and HC (0%) participants (Table 1; Figure 1). In addition, relative to HCs, CHR-P participants more commonly disclosed current suicidal ideation (34.6%), current self-harm intention (28.5%) and lifetime self-harm behaviour (28.5%) whilst CHR-N participants were more likely to report current suicidal ideation (19.1%). Current self-harm intention was also reported significantly more in CHR-P

TABLE 1 Demographic, clinical, functional and cognitive characteristics of the total sample (N = 245)

	CHR-P (1) (N = 130)	FEP (2) (N = 15)	CHR-N (3) (N = 47)	HC (4) (N = 53)	P	Effect size[a]	Post hoc test[b]
Age (years), mean (SD)	21.64 (4.27)	23.73 (4.79)	22.94 (4.80)	22.42 (3.36)	.044	η^2_p = 0.033	..
Gender, female n (%)	94 (72.3)	10 (66.7)	30 (63.8)	36 (67.9)	.727	V = 0.073	..
Education (years), mean (SD)	15.40 (2.95)	15.80 (3.38)	16.45 (3.44)	16.47 (2.85)	.070	η^2_p = 0.029	
Suicidality and self-harm, n (%)							
Self-harm intention (past month)	37 (28.5)	..	4 (8.5)	0 (0)	<.001	V = 0.325	1 > 3,4
Self-harm behaviour (past month)	7 (5.4)	3 (20.0)	0 (0)	0 (0)	.005	V = 0.244	2 > 3,4
Self-harm behaviour (lifetime)	37 (28.5)	9 (60.0)	5 (10.6)	2 (3.8)	<.001	V = 0.349	2 > 3,4 & 1 > 4
Suicide plan (past month)	12 (9.2)	1 (6.7)	3 (6.4)	1 (1.9)	.332	V = 0.114	..
Suicidal ideation (past month)	45 (34.6)	11 (73.3)	9 (19.1)	1 (1.9)	<.001	V = 0.397	2 > 1,3,4 & 1,3 > 4
Suicide attempt (past month)	3 (2.3)	1 (6.7)	0 (0)	0 (0)	.201	V = 0.134	..
Suicide attempt (lifetime)	38 (29.2)	9 (60.0)	4 (8.5)	0 (0)	<.001	V = 0.393	1,2 > 3,4
MINI suicidality risk, n (%)							
Low	28 (21.5)	..	3 (6.4)	1 (1.9)	.001	V = 0.255	1 > 4
Moderate	21 (16.2)	..	3 (6.4)	0 (0)	.003	V = 0.224	1 > 4
High	21 (16.2)	..	5 (10.6)	0 (0)	.007	V = 0.207	1,3 > 4
CAARMS severity, median (range)	29 (0-74)	88 (38-122)	6 (0-24)	0 (0-12)	<.001	η^2_p = 0.408	2 > 1 > 3 > 4
SPI-A severity, median (range)	7 (0-74)	14 (0-109)	0 (0-7)	0 (0-2)	<.001	η^2_p = 0.338	1, 2 > 3,4
ACES total, median (range)	2 (0-8)	..	1 (0-5)	0 (0-4)	<.001	η^2_p = 0.111	1 > 4
Comorbidity, median (range)	2 (0-5)	..	1 (0-3)	0 (0)	<.001	η^2_p = 0.306	1,3 > 4 & 1 > 3
Psychological treatment, n (%)							
Current	21 (16.2)	3 (20.0)	5 (10.6)	0 (0)	.015	V = 0.207	1,2 > 4
Past	59 (45.4)	9 (60.0)	15 (31.9)	3 (5.7)	<.001	V = 0.353	1,2,3 > 4
Medication, n (%)							
Antidepressants	46 (35.4)	7 (46.7)	13 (27.7)	0 (0)	<.001	V = 0.333	1,2,3 > 4
Mood stabilisers	4 (3.1)	0 (0)	0 (0)	0 (0)	.534	V = 0.121	..
Antipsychotics	2 (1.5)	2 (13.3)	0 (0)	0 (0)	.039	V = 0.243	2 > 1,4
Anxiolytics	8 (6.2)	2 (13.3)	1 (2.1)	0 (0)	.060	V = 0.165	..
Social functioning (current), median (range)	8 (3-10)	..	8 (6-9)	9 (8-10)	<.001	η^2_p = 0.224	4 > 1,3 & 3 > 1
Role functioning (current), median (range)	8 (3-9)	..	8 (5-9)	9 (5-9)	<.001	η^2_p = 0.191	4 > 1,3 & 3 > 1
PAS average, median (range)	1.20 (0-3.43)	..	0.86 (0-3.86)	0.43 (0-1.64)	<.001	η^2_p = 0.183	1,3 > 4
Social support, mean (SD)	5.05 (0.89)	..	5.30 (0.87)	6.02 (0.59)	<.001	η^2_p = 0.168	4 > 1,3
Insecure attachment, mean (SD)	1.75 (0.46)	..	1.41 (0.50)	1.01 (0.46)	<.001	η^2_p = 0.226	1,3 > 4 & 1 > 3
BACS composite score, mean (SD)	-0.39 (1.64)	..	-0.02 (1.38)	0 (1.01)	.140	η^2_p = 0.017	..

Note: CHR-P, clinical high-risk for psychosis; FEP, first episode psychosis; CHR-N, clinical high-risk-negative; HC, healthy control; MINI, Mini-International Neuropsychiatric Interview; CAARMS, Comprehensive Assessment of At-Risk Mental States; SPI-A, Schizophrenia Proneness Instrument, Adult version; ACES, Adverse Childhood Experiences Scale; PAS, Premorbid Adjustment Scale; BACS, Brief Assessment of Cognition in Schizophrenia.

[a]Effect sizes were eta squared (η^2_p) for Kruskal-Wallis H tests (small effect = 0.01, medium effect = 0.06, large effect = 0.14) and Cramer's V for Pearson's chi-square or Fisher-Freeman-Halton tests (small effect = 0.1, medium effect = 0.3, large effect = 0.5).

[b]1 = CHR-P, 2= FEP, 3 = HC, 4 = CHR-N

than in CHR-N individuals (28.5 vs. 8.5%). Overall, 32.4% of CHR-P and 17.0% of CHR-N participants were categorised as currently at moderate- to high-risk of suicide. The FEP group was at greatest risk, with considerably high prevalence rates for current suicidal ideation (73.3%), lifetime self-harm behaviour (60.0%) and lifetime suicide attempt (60.0%).

3.3 | Impact of recruitment pathway

We further compared our community-recruited CHR-P sample to a smaller group of CHR-P individuals (*n* = 16) recruited via referrals from clinical services in NHS Greater Glasgow and Clyde and NHS Lothian as well as student counselling services (Table S1). Referred
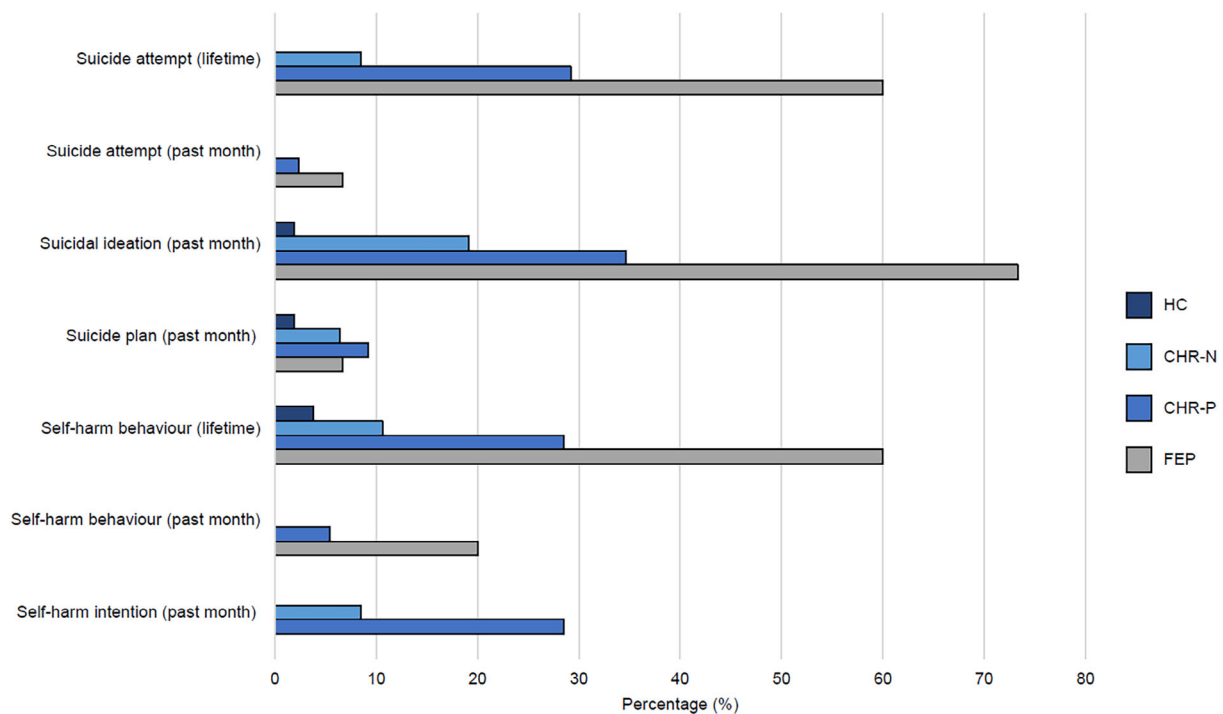
FIGURE 1 Suicidality and self-harm profile of the total sample (N = 245)

participants had significantly fewer years of education, poorer functioning and lower BACS composite score than community-recruited participants. However, no significant group differences were observed on suicide-related variables.

3.4 | Predictors of current suicidal ideation in CHR-P participants

Multivariable logistic regression analysis was used to determine predictors of current suicidal ideation in CHR-P individuals. We did not identify any sources of multicollinearity among the potential predictor variables.

Predictors of current suicidal ideation in CHR-P participants included lifetime suicide attempts, lower CAARMS severity, impaired social functioning and premorbid adjustment and greater comorbidity although premorbid adjustment did not contribute significantly to the model (Table 2). This model explained 32.4% of the variance with an acceptable AUC of 0.797 (p < .001), specificity of 82.4% and sensitivity of 46.7% (Figure 2).

4 | DISCUSSION

We examined the prevalence of suicidality and self-harm in CHR-P and FEP samples as well as predictors of current suicidal ideation in CHR-P individuals. Our findings suggest that suicidality and self-harm are highly prevalent in community-recruited CHR-P and FEP groups with the latter at greatest risk. In addition, lifetime suicide attempts, lower CAARMS severity, impaired social functioning and greater

comorbidity significantly predicted current suicidal ideation in CHR-P participants.

4.1 | Suicidality and self-harm prevalence

Our findings highlight significant levels of suicidality and self-harm in CHR-P individuals recruited from the community. Current suicidal ideation was most commonly disclosed with a prevalence rate of 34.6%, comparable to previous estimates of 30% (DeVylder et al., 2012) and 42.9% (Gill et al., 2015) within help-seeking UHR samples. Similarly large proportions of our CHR-P sample reported lifetime suicide attempts (29.2%), lifetime self-harm behaviour (28.5%) and current self-harm intention (28.5%). Interestingly, prevalence estimates for lifetime suicide attempts are generally lower in help-seeking UHR samples, ranging between 8.6 and 18% (Pelizza et al., 2019, 2020; Preti et al., 2009; Taylor et al., 2015). One possibility is that clinically-recruited UHR participants, through their established contact with mental health services, have better coping skills in comparison to community-recruited individuals. Overall, the current findings demonstrate that high rates of suicidality and self-harm are not restricted to clinically recruited UHR samples.

In contrast to previous studies, our results suggest that suicidality and self-harm are more prevalent in FEP as compared to CHR-P participants, especially with regard to current suicidal ideation (L. Pelizza et al., 2019, 2020; Preti et al., 2009). Our FEP group exhibited prevalence rates for current suicidal ideation (73.3%), lifetime self-harm behaviour (60.0%) and lifetime suicide attempts (60.0%) that were

TABLE 2   Multivariable logistic regression model for suicidal ideation (past month) in CHR-P participants (N = 130)

Variable	Beta	SE	Wald	p	OR (95% CI)	AUC (SE) [95% CI]	R^2_N	Sensitivity	Specificity
Suicide attempt (lifetime)	0.994	0.484	4.221	.040	2.701 (1.047–6.969)				
CAARMS severity	−0.030	0.015	4.110	.043	0.971 (0.943–0.999)	0.797 (0.039) [0.720–0.874]	0.324	46.7	82.4
Social functioning (current)	−0.496	0.216	5.246	.022	0.609 (0.399–0.931)				
Premorbid adjustment	0.577	0.344	2.804	.094	1.780 (0.906–3.495)				
Comorbidity	0.489	0.199	6.030	.014	1.631 (1.104–2.411)				

Note: Beta, unstandardised regression coefficient.

Abbreviations: AUC, area under the curve; CI, confidence interval; OR, odds ratio; R^2_N, Nagelkerke pseudo R^2 statistic.
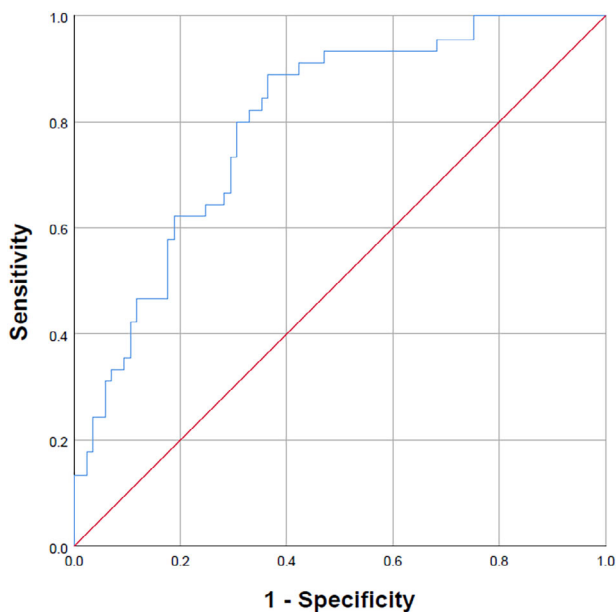
FIGURE 2   Receiver-operating characteristic curve for the multivariable logistic regression model predicting suicidal ideation (past month) in clinical high-risk for psychosis participants (N = 130)

approximately two to 11 times greater than those typically reported in FEP samples (Bertelsen et al., 2007; Challis et al., 2013; Pelizza et al., 2020; Preti et al., 2009), possibly resulting from our focus on community-recruitment. Indeed, given that only 20.0% of FEP participants were in current psychological treatment and 13.3% received antipsychotics, these individuals may not be receiving appropriate clinical attention and support for their heightened psychotic symptoms and associated distress, thereby increasing suicidality risk.

Notably, CHR-N individuals were characterised by relatively modest suicidality and self-harm, potentially attributable to the lower comorbidity and better functioning observed in this group relative to the CHR-P sample. Significantly more CHR-N participants reported current suicidal ideation (19.1%) compared to HCs (1.9%), however; contrasting with the higher prevalence rates of 33.3% (L. Pelizza et al., 2020) and 45% (L. Pelizza et al., 2019) reported in help-seeking samples.

4.2 | Predictors of current suicidal ideation in CHR-P participants

In the CHR-P group, significant predictors of current suicidal ideation included lifetime suicide attempts, lower CAARMS severity, impaired social functioning and greater comorbidity. The final model explained 32.4% of the variance in current suicidal ideation, in line with previous findings in help-seeking UHR cohorts (Bang et al., 2017; L. Pelizza et al., 2019).

Our results also concur with prior research in UHR and schizophrenia samples wherein depressive mood, increased psychiatric comorbidity and poor functioning have emerged as predictors of suicidal ideation (Andriopoulos et al., 2011; Bornheimer, 2016; Harvey et al., 2018; L. Pelizza et al., 2019). Furthermore, these findings are in accordance with the interpersonal theory of suicide (Joiner, 2005; Van Orden et al., 2010) which implicates perceived alienation from, and lack of meaningful connections with, friends, family and others (i.e., thwarted belongingness). The emergence of lower, rather than higher, CAARMS severity as a significant predictor of current suicidal ideation, however, contrasts with previous findings in help-seeking UHR samples (Bang et al., 2017).

Overall, the strongest predictor of current suicidal ideation was lifetime suicide attempts, concurring with previous findings in schizophrenia (Kim et al., 2010). Given that suicidal ideation is also highly predictive of future suicide attempts and completed suicide in both schizophrenia samples and psychiatric patient populations (Bertelsen et al., 2007; Fosse et al., 2017; Horwitz et al., 2015; Lopez-Morinigo et al., 2016), effectively identifying CHR-P individuals with current suicidal ideation is a critical step towards managing risk and reducing suicide deaths.

Contrary to findings from the general population (E.M. Kleiman & Liu, 2013; Kosidou et al., 2014; Sörberg et al., 2013; Zortea et al., 2019), social support, insecure attachment orientations and cognitive ability did not emerge as predictors of suicidality, perhaps owing to differing assessment measures. In addition, although characterised by excellent specificity, the prediction model yielded limited sensitivity. This issue is commonly noted for suicide prediction models, which may limit their clinical value (Kessler et al., 2020). In order to optimise model performance, future research should consider employing

advanced machine learning methods as well as more comprehensive predictor sets incorporating, for example, biological predictors.

4.3 | Limitations

The sample size of CHR-P participants with current suicidal ideation was relatively small, limiting the number of variables that could be included in a single model and perhaps reducing the generalisability of the findings.

In addition, information regarding suicidality and self-harm was elicited via self-report questions—a method particularly susceptible to social desirability response bias; or to exaggeration by individuals seeking help. Our methodological approach also involved a single retrospective assessment of suicidality and self-harm (e.g., past month/lifetime). Given that suicidal ideation is known to fluctuate rapidly over just a few hours, this approach may be of limited value (E.M. Kleiman et al., 2017). In order to capture fine-grained variation in suicidality and self-harm, future research should turn to time-intensive techniques such as ecological momentary assessment which allow data to be collected repeatedly, in real-time and in naturalistic settings (de Beurs et al., 2015).

5 | CONCLUSIONS

Our findings emphasise the high prevalence of suicidality and self-harm in community-recruited CHR-P and FEP individuals. Moreover, we demonstrated that lifetime suicide attempts, lower CAARMS severity, impaired social functioning and greater comorbidity were able to significantly predict current suicidal ideation in CHR-P participants, with lifetime suicide attempts comprising the strongest predictor. Therefore, the current findings highlight that CHR-P individuals recruited outside traditional early intervention services represent a vulnerable group that requires novel approaches for detection; and early intervention aimed at suicide prevention. Whether prediction models can be applied to suicidality prevention in CHR-P samples remains, however, an open question. We expect that, by incorporating larger collaborative datasets, longitudinal study designs, machine learning approaches and real-time measures, model performance will improve, thereby optimising youth mental health.

DATA AVAILABILITY STATEMENT
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

ORCID
Kate Haining https://orcid.org/0000-0002-4500-1395
Ruchika Gajwani https://orcid.org/0000-0002-1199-320X
Frauke Schultze-Lutter https://orcid.org/0000-0003-1956-9574
Peter J. Uhlhaas https://orcid.org/0000-0002-0892-2224

REFERENCES
Aaltonen, K., Näätänen, P., Heikkinen, M., Koivisto, M., Baryshnikov, I., Karpov, B., Oksanen, J., Melartin, T., Suominen, K., Joffe, G., Paunio, T., & Isometsä, E. (2016). Differences and similarities of risk factors for suicidal ideation and attempts among patients with depressive or bipolar disorders. *Journal of Affective Disorders*, *193*, 318–330. https://doi.org/10.1016/j.jad.2015.12.033.

Andriopoulos, I., Ellul, J., Skokou, M., & Beratis, S. (2011). Suicidality in the "prodromal" phase of schizophrenia. *Comprehensive Psychiatry*, *52*(5), 479–485. https://doi.org/10.1016/j.comppsych.2010.10.011.

Bang, M., Park, J. Y., Kim, K. R., Lee, S. Y., Song, Y. Y., Kang, J. I., Lee, E., & An, S. K. (2017). Suicidal ideation in individuals at ultra-high risk for psychosis and its association with suspiciousness independent of depression. *Early Intervention in Psychiatry*, *13*, 539–545. https://doi.org/10.1111/eip.12517.

Berry, K., Wearden, A., Barrowclough, C., & Liversidge, T. (2006). Attachment styles, interpersonal relationships and psychotic phenomena in a non-clinical student sample. *Personality and Individual Differences*, *41*(4), 707–718. https://doi.org/10.1016/j.paid.2006.03.009.

Bertelsen, M., Jeppesen, P., Petersen, L., Thorup, A., Øhlenschlæger, J., Le Quach, P., … Nordentoft, M. (2007). Suicidal behaviour and mortality in first-episode psychosis: The OPUS trial. *British Journal of Psychiatry*, *191*(Suppl. 51), s140–s146. https://doi.org/10.1192/bjp.191.51.s140.

Bornheimer, L. A. (2016). Moderating effects of positive symptoms of psychosis in suicidal ideation among adults diagnosed with schizophrenia. *Schizophrenia Research*, *176*(2–3), 364–370. https://doi.org/10.1016/j.schres.2016.07.009.

Cannon-Spoor, H. E., Potkin, S. G., & Wyatt, R. J. (1982). Measurement of premorbid adjustment in chronic schizophrenia. *Schizophrenia Bulletin*, *8*(3), 470–484. https://doi.org/10.1093/schbul/8.3.470.

Carrión, R. E., McLaughlin, D., Goldberg, T. E., Auther, A. M., Olsen, R. H., Olvet, D. M., Correll, C. U., & Cornblatt, B. A. (2013). Prediction of functional outcome in individuals at clinical high risk for psychosis. *JAMA Psychiatry*, *70*(11), 1133–1142. https://doi.org/10.1001/jamapsychiatry.2013.1909.

Challis, S., Nielssen, O., Harris, A., & Large, M. (2013). Systematic meta-analysis of the risk factors for deliberate self-harm before and after treatment for first-episode psychosis. *Acta Psychiatrica Scandinavica*, *127*(6), 442–454. https://doi.org/10.1111/acps.12074.

Cornblatt, B. A., Auther, A. M., Niendam, T., Smith, C. W., Zinberg, J., Bearden, C. E., & Cannon, T. D. (2007). Preliminary findings for two new measures of social and role functioning in the prodromal phase of schizophrenia. *Schizophrenia Bulletin*, *33*(3), 688–702. https://doi.org/10.1093/schbul/sbm029.

de Beurs, D., Kirtley, O., Kerkhof, A., Portzky, G., & O'Connor, R. C. (2015). The role of mobile phone technology in understanding and preventing suicidal behavior. *Crisis*, *36*(2), 79–82. https://doi.org/10.1027/0227-5910/a000316.

DeVylder, J. E., Oh, A. J., Ben-David, S., Azimov, N., Harkavy-Friedman, J. M., & Corcoran, C. M. (2012). Obsessive compulsive symptoms in individuals at clinical risk for psychosis: Association with depressive symptoms and suicidal ideation. *Schizophrenia Research*, *140*(1–3), 110–113, 113. https://doi.org/10.1016/j.schres.2012.07.009.

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., … Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The adverse childhood experiences (ACE) study. *American Journal of Preventive Medicine*, *14*(4), 245–258. https://doi.org/10.1016/s0749-3797(98)00017-8.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (2002). *Structured clinical interview for DSM-IV-TR axis I disorders, research version, patient edition. (SCID - I/P)*. New York: Biometrics Research, New York State Psychiatric Institute.

Fosse, R., Ryberg, W., Carlsson, M. K., & Hammer, J. (2017). Predictors of suicide in the patient population admitted to a locked-door psychiatric acute ward. *PLoS One*, *12*(3), 1–13. https://doi.org/10.1371/journal.pone.0173958.

Fuller-Thomson, E., & Hollister, B. (2016). Schizophrenia and suicide attempts: Findings from a representative community-based Canadian sample. *Schizophrenia Research and Treatment*, *2016*(3165243), 1–11. https://doi.org/10.1155/2016/3165243.

Fusar-Poli, P., Cappucciati, M., Borgwardt, S., Woods, S. W., Addington, J., Nelson, B., Nieman, D. H., Stahl, D. R., Rutigliano, G., Riecher-Rössler, A., Simon, A. E., Mizuno, M., Lee, T. Y., Kwon, J. S., Lam, M. M. L., Perez, J., Keri, S., Amminger, P., Metzler, S., … McGuire, P. K. (2016). Heterogeneity of psychosis risk within individuals at clinical high risk: A meta-analytical stratification. *JAMA Psychiatry*, *73*(2), 113–120. https://doi.org/10.1001/jamapsychiatry.2015.2324.

Fusar-Poli, P., Schultze-Lutter, F., Cappucciati, M., Rutigliano, G., Bonoldi, I., Stahl, D., … Mcguire, P. (2016). The dark side of the moon: Meta-analytical impact of recruitment strategies on risk enrichment in the clinical high risk state for psychosis. *Schizophrenia Bulletin*, *42*(3), 732–743. https://doi.org/10.1093/schbul/sbv162.

Gill, K. E., Quintero, J. M., Poe, S. L., Moreira, A. D., Brucato, G., Corcoran, C. M., & Girgis, R. R. (2015). Assessing suicidal ideation in individuals at clinical high risk for psychosis. *Schizophrenia Research*, *165*(2–3), 152–156. https://doi.org/10.1016/j.schres.2015.04.022.

Harvey, P. D., Posner, K., Rajeevan, N., Yershova, K. V., Aslan, M., & Concato, J. (2018). Suicidal ideation and behavior in US veterans with schizophrenia or bipolar disorder. *Journal of Psychiatric Research*, *102*, 216–222. https://doi.org/10.1016/j.jpsychires.2018.04.014.

Horwitz, A. G., Czyz, E. K., & King, C. A. (2015). Predicting future suicide attempts among adolescent and emerging adult psychiatric emergency patients. *Journal of Clinical Child and Adolescent Psychology*, *44*(5), 751–761. https://doi.org/10.1080/15374416.2014.910789.

Ising, H. K., Veling, W., Loewy, R. L., Rietveld, M. W., Rietdijk, J., Dragt, S., … Van Der Gaag, M. (2012). The validity of the 16-item version of the prodromal questionnaire (PQ-16) to screen for ultra high risk of developing psychosis in the general help-seeking population. *Schizophrenia Bulletin*, *38*(6), 1288–1296. https://doi.org/10.1093/schbul/sbs068.

Joiner, T. E. (2005). *Why people die by suicide*. Cambridge, MA: Harvard University Press.

Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophrenia Bulletin*, *13*(2), 261–276. https://doi.org/10.1093/schbul/13.2.261.

Keefe, R. S. E., Goldberg, T. E., Harvey, P. D., Gold, J. M., Poe, M. P., & Coughenour, L. (2004). The brief assessment of cognition in schizophrenia: Reliability, sensitivity, and comparison with a standard neurocognitive battery. *Schizophrenia Research*, *68*(2–3), 283–297. https://doi.org/10.1016/j.schres.2003.09.011.

Kessler, R. C., Bossarte, R. M., Luedtke, A., Zaslavsky, A. M., & Zubizarreta, J. R. (2020). Suicide prediction models: A critical review of recent research with recommendations for the way forward. *Molecular Psychiatry*, *25*(1), 168–179. https://doi.org/10.1038/s41380-019-0531-0.

Kim, S. W., Kim, S. J., Mun, J. W., Bae, K. Y., Kim, J. M., Kim, S. Y., Yang, S. J., Shin, I. S., & Yoon, J. S. (2010). Psychosocial factors contributing to suicidal ideation in hospitalized schizophrenia patients in Korea. *Psychiatry Investigation*, *7*(2), 79–85. https://doi.org/10.4306/pi.2010.7.2.79.

Kleiman, E. M., & Liu, R. T. (2013). Social support as a protective factor in suicide: Findings from two nationally representative samples. *Journal of Affective Disorders*, *150*(2), 540–545. https://doi.org/10.1016/j.jad.2013.01.033.

Kleiman, E. M., Turner, B. J., Fedor, S., Beale, E. E., Huffman, J. C., & Nock, M. K. (2017). Examination of real-time fluctuations in suicidal ideation and its risk factors: Results from two ecological momentary assessment studies. *Journal of Abnormal Psychology*, *126*(6), 726–738. https://doi.org/10.1037/abn0000273.

Kosidou, K., Dalman, C., Fredlund, P., & Magnusson, C. (2014). School performance and the risk of suicidal thoughts in young adults: Population-based study. *PLoS One*, *9*(10), e109958. https://doi.org/10.1371/journal.pone.0109958.

Lopez-Morinigo, J. D., Ayesa-Arriola, R., Torres-Romano, B., Fernandes, A. C., Shetty, H., Broadbent, M., Dominguez-Ballesteros, M. E., Stewart, R., David, A. S., & Dutta, R. (2016). Risk assessment and suicide by patients with schizophrenia in secondary mental healthcare: A case-control study. *BMJ Open*, *6*(9), 1–10. https://doi.org/10.1136/bmjopen-2016-011929.

McDonald, M., Christoforidou, E., Van Rijsbergen, N., Gajwani, R., Gross, J., Gumley, A. I., … Uhlhaas, P. J. (2019). Using online screening in the general population to detect participants at clinical high-risk for psychosis. *Schizophrenia Bulletin*, *45*(3), 600–609. https://doi.org/10.1093/schbul/sby069.

Michel, C., Ruhrmann, S., Schimmelmann, B. G., Klosterkötter, J., & Schultze-Lutter, F. (2018). Course of clinical high-risk states for psychosis beyond conversion. *European Archives of Psychiatry and Clinical Neuroscience*, *268*(1), 39–48. https://doi.org/10.1007/s00406-016-0764-8.

Nordentoft, M., Laursen, T. M., Agerbo, E., Qin, P., Høyer, E. H., & Mortensen, P. B. (2004). Change in suicide rates for patients with schizophrenia in Denmark, 1981-97: Nested case-control study. *British Medical Journal*, *329*(7460), 261–264. https://doi.org/10.1136/bmj.38133.622488.63.

Palmer, B. A., Pankratz, V. S., & Bostwick, J. M. (2005). The lifetime risk of suicide in schizophrenia: A reexamination. *Archives of General Psychiatry*, *62*(3), 247–253. https://doi.org/10.1001/archpsyc.62.3.247.

Pelizza, L., Poletti, M., Azzali, S., Paterlini, F., Garlassi, S., Scazza, I., Chiri, L. R., Pupo, S., & Raballo, A. (2019). Suicidal thinking and behavior in adolescents at ultra-high risk of psychosis: A two-year longitudinal study. *Suicide and Life-threatening Behavior*, *49*(6), 1637–1652. https://doi.org/10.1111/sltb.12549.

Pelizza, L., Poletti, M., Azzali, S., Paterlini, F., Garlassi, S., Scazza, I., … Raballo, A. (2020). Suicide risk in young people at ultra-high risk (UHR) of psychosis: Findings from a 2-year longitudinal study. *Schizophrenia Research*, *220*, 98–105. https://doi.org/10.1016/j.schres.2020.03.051.

Power, M. J., Champion, L. A., & Aris, S. J. (1988). The development of a measure of social support: The significant others (SOS) scale. *British Journal of Clinical Psychology*, *27*(4), 349–358. https://doi.org/10.1111/j.2044-8260.1988.tb00799.x.

Preti, A., Meneghelli, A., Pisano, A., & Cocchi, A. (2009). Risk of suicide and suicidal ideation in psychosis: Results from an Italian multi-modal pilot program on early intervention in psychosis. *Schizophrenia Research*, *113*(2–3), 145–150. https://doi.org/10.1016/j.schres.2009.06.007.

Schultze-Lutter, F. (2009). Subjective symptoms of schizophrenia in research and the clinic: The basic symptom concept. *Schizophrenia Bulletin*, *35*(1), 5–8. https://doi.org/10.1093/schbul/sbn139.

Schultze-Lutter, F., Addington, J., Ruhrmann, S., & Klosterkötter, J. (2007). *Schizophrenia Proneness Instrument-Adult Version (SPI-A)*. Rome, Italy: Giovanni Fioriti Editore.

Schultze-Lutter, F., Ruhrmann, S., Fusar-Poli, P., Bechdolf, A., Schimmelmann, B. G., & Klosterkotter, J. (2012). Basic symptoms and the prediction of first-episode psychosis. *Current Pharmaceutical Design*, *18*(4), 351–357.

Sheehan, D. V., Lecrubier, Y., Sheehan, K., Amorim, P., Janavs, J., Weiller, E., … Dunbar, G. C. (1998). The Mini-international neuropsychiatric interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *The Journal of Clinical Psychiatry*, *59*(Suppl. 20), 22–33.

Sörberg, A., Allebeck, P., Melin, B., Gunnell, D., & Hemmingsson, T. (2013). Cognitive ability in early adulthood is associated with later suicide and suicide attempt: The role of risk factors over the life course. *Psychological Medicine*, *43*(1), 49–60. https://doi.org/10.1017/S0033291712001043.

Taylor, P. J., Hutton, P., & Wood, L. (2015). Are people at risk of psychosis also at risk of suicide and self-harm? A systematic review and meta-analysis. *Psychological Medicine*, *45*(5), 911–926. https://doi.org/10.1017/S0033291714002074.

Too, L. S., Spittal, M. J., Bugeja, L., Reifels, L., Butterworth, P., & Pirkis, J. (2019). The association between mental disorders and suicide: A systematic review and meta-analysis of record linkage studies. *Journal of Affective Disorders*, *259*, 302–313. https://doi.org/10.1016/j.jad.2019.08.054.

Uhlhaas, P. J., Gajwani, R., Gross, J., Gumley, A. I., Lawrie, S. M., & Schwannauer, M. (2017). The youth mental health risk and resilience study (YouR-study). *BMC Psychiatry*, *17*(1), 1–8. https://doi.org/10.1186/s12888-017-1206-5.

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E. (2010). The interpersonal theory of suicide. *Psychological Review*, *117*(2), 575–600. https://doi.org/10.1037/a0018697.

Vittinghoff, E., & McCulloch, C. E. (2007). Relaxing the rule of ten events per variable in logistic and cox regression. *American Journal of Epidemiology*, *165*(6), 710–718. https://doi.org/10.1093/aje/kwk052.

Yung, A. R., Yuen, H. P., McGorry, P. D., Phillips, L. J., Kelly, D., Dell'Olio, M., … Buckby, J. (2005). Mapping the onset of psychosis: The comprehensive assessment of at-risk mental states. *Australian and New Zealand Journal of Psychiatry*, *39*(11–12), 964–971. https://doi.org/10.1111/j.1440-1614.2005.01714.x.

Zortea, T. C., Gray, C. M., & O'Connor, R. C. (2019). The relationship between adult attachment and suicidal thoughts and behaviors: A systematic review. *Archives of Suicide Research*, 1–36. Advance online publication. https://doi.org/10.1080/13811118.2019.1661893.

Zuschlag, Z. D., Korte, J. E., & Hamner, M. (2018). Predictors of lifetime suicide attempts in individuals with attenuated psychosis syndrome. *Journal of Psychiatric Practice*, *24*(3), 169–178. https://doi.org/10.1097/PRA.0000000000000303.

AUTHOR BIOGRAPHIES

Kate Haining is a PhD candidate at the Institute of Neuroscience and Psychology, University of Glasgow. She is particularly interested in the predictors of clinical and functional outcomes in individuals at clinical high-risk for psychosis. She is also implementing a cognitive remediation intervention in participants at-risk of, or experiencing a first-episode of, psychosis. She aims to determine the impact of this approach on cognitive performance and neural circuitry, as assessed via magnetoencephalography.

Olga Karagiorgou is a trainee clinical psychologist at Newcastle University. She has research interests in clinical neuropsychology and rehabilitation. She is currently involved in the designing of a hospital version of the Multiple Errands Test - an executive function test and also, in the reviewing of dialectical behaviour therapy and mentalisation-based therapy for adolescents with borderline personality traits.

Dr Ruchika Gajwani is a Clinical Psychology Research Fellow at the Institute of Health and Wellbeing, University of Glasgow. She is an Honorary Clinical Psychologist at the Child and Adolescent Mental Health Services, NHS Greater Glasgow and Clyde. Dr Gajwani is involved in research on youth mental health, with a particular interest in early detection and intervention. Her scientific interest is in understanding the extent to which genetic and environmental factors contribute to mental health difficulties, with a specific focus on neurodiversity and adverse childhood experiences.

Joachim Gross is Professor of Systems Neuroscience, Acting Director of the Centre for Cognitive Neuroimaging and Wellcome Trust Senior Investigator, University of Glasgow. He is also Director of the Institute for Biomagnetism and Biosignalanalysis, WWU Münster. His group investigates the functional role of brain oscillations using neuroimaging and computational methods. His main goal is to understand how brain oscillations support perception and action.

Andrew I. Gumley is a Professor of Psychological Therapy in the Institute of Health and Wellbeing in the University of Glasgow. He is Consultant Clinical Psychologist in the ESTEEM Early Intervention Psychosis Service in NHS Greater Glasgow & Clyde. He is Director of the NHS Research Scotland Mental Health Network. His research interests encompass mechanisms of relapse and recovery in people with experiences of psychosis and their treatment.

Stephen M. Lawrie is a Professor of Psychiatry at the University of Edinburgh and Honorary Consultant Psychiatrist with NHS Lothian. He is a Fellow of the Royal College of Psychiatrists, the Royal College of Physicians of Edinburgh, the European College of Neuropsychopharmacology, the Beltane Public Engagement Network and the Royal Society of Edinburgh. He is particularly interested in clinical applications of brain imaging in psychosis and in the development of novel treatments that might enhance outcomes in established schizophrenia and possibly even prevent psychosis in high risk populations.

Matthias Schwannauer, MA, MSc, DPsych, PhD, CPsychol, AFBPsS, Head of School of Health in Social Science and Professor of Clinical Psychology at The University of Edinburgh, Consultant Clinical Psychologist, CAMHS, NHS Lothian, graduated in clinical and applied psychology from the University of Marburg in 1998. He moved to NHS Lothian and the University of Edinburgh in 2000. His research group is focused on investigating developmental trajectories of mental health and wellbeing across

the life span and the development of current psychological models of emotional distress and mental health. His research interests include the application of attachment theory, reflective function and psychological processes in relation to neurodevelopmental processes to further our understanding of the development, adaptation to and recovery from severe mental health conditions, particular psychosis and recurrent mood disorders, with a particular focus on psychological and developmental transitions, both from childhood into adolescence and from adolescence into early adulthood.

Dr. Frauke Schultze-Lutter was trained in clinical psychology and is Assistant Professor at the Department of Psychiatry and Psychotherapy of the Heinrich-Heine University, Düsseldorf, Germany, and head of the research unit "Early Detection" and of the early detection and intervention services. Furthermore, she is Adjunct Professor at the Department of Psychology and Mental Health, Faculty of Psychology, Airlangga University, Surabaya, Indonesia, and guest lecturer at the University Hospital of Child and Adolescent Psychiatry and Psychotherapy, University of Bern, Bern, Switzerland. Working in the early detection of psychoses since 1994, she is an internationally recognized expert in this field and well-experienced in epidemiological studies and in clinical high-risk studies in children, adolescents and adults. She developed the basic symptom criteria as a complimentary approach to

the ultra-high-risk approach and has authored more than 100 original publications in international journals.

Peter Uhlhaas is Professor at the Department of Child and Adolescent Psychiatry, Charite, Universitätsmedizin Berlin, and at the Institute of Neuroscience and Psychology, University of Glasgow. He trained at the University of Stirling, Weill Medical College of Cornell University, and Max-Planck Institute for Brain Research in Frankfurt, Germany. His current research focuses on the development of biomarkers for the detection and diagnosis of early-stage psychosis as well as on innovative E-mental health tools.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.