European Neuropsychopharmacology 85 (2024) 66–77

Contents lists available at ScienceDirect

European Neuropsychopharmacology

journal homepage: www.sciencedirect.com/journal/european-neuropsychopharmacology

Emotional intelligence and neurocognition profiles in first-episode psychosis: A two-year follow-up study

Derek Clougher [a,c,1], Maria Florencia Forte [a,b,1], Gisela Mezquida [b,d], Ana M. Sánchez-Torres [e,f], Maria Serra-Navarro [a], Rafael Penadés [b], Antonio Lobo [g], Ana González Pinto [c], Rocío Panadero [h], Alexandra Roldán [i], Eduard Vieta [a,*], Elena de la Serna [j], Amira Trabsa [k], Anabel Martínez-Aran [a], Carla Torrent [a,2], Alfonso Tortorella [l], Giulia Menculini [l], Josep Antoni Ramos-Quiroga [m], Manuel J. Cuesta [e], Miquel Bernardo [b], Silvia Amoretti [a,b,m], PEPs group [3]

[a] Bipolar and Depressive Disorders Unit, Hospital Clínic de Barcelona; Departament de Medicina, Institut de Neurociències (UBNeuro), Universitat de Barcelona (UB); Fundació Clínic-Institut d'Investigacions Biomèdiques August Pi I Sunyer (IDIBAPS); CIBERSAM, ISCIII, Barcelona, Spain
[b] Barcelona Clinic Schizophrenia Unit, Hospital Clínic de Barcelona; Departament de Medicina, Institut de Neurociències (UBNeuro), Universitat de Barcelona (UB); Institut d'Investigacions Biomèdiques August Pi I Sunyer (IDIBAPS); CIBERSAM, ISCIII, Barcelona, Spain
[c] BIOARABA, Department Psychiatry. Hospital Universitario de Alava. CIBERSAM. University of the Basque Country, Vitoria, Spain
[d] Serra-Hunter Fellow, Department of Basic Clinal Practice, Pharmacology Unit, University of Barcelona
[e] Department of Psychiatry, Hospital Universitario de Navarra, Pamplona, Spain; Navarra Institute of Health Research (IdiSNA), Pamplona, Spain Department of Health Sciences, Universidad Pública de Navarra, Pamplona, Spain
[f] Departamento de Ciencias de la Salud, Universidad Pública de Navarra (UPNA), Campus de Arrosadia, 31006, Pamplona, España
[g] Department of Medicine and Psychiatry, Zaragoza University. Instituto de Investigación Sanitaria Aragón (IIS Aragón), CIBERSAM, ISCIII, Zaragoza, Spain
[h] Department of Child and Adolescent Psychiatry, Institute of Psychiatry and Mental Health, Hospital General Universitario Gregorio Marañón, IiSGM, CIBERSAM, School of Medicine, Universidad Complutense, Madrid, Spain
[i] Psychiatry Department, Hospital de la Santa Creu i Sant Pau, IIB SANT PAU, CIBERSAM, Barcelona, Spain
[j] Child and Adolescent Psychiatry and Psychology Department, 2017SGR881, Institute of Neurosciences, Hospital Clinic of Barcelona, Department of Medicine, University of Barcelona, Barcelona, Spain
[k] Hospital del Mar Medical Research Institute; Universitat Pompeu Fabra, MELIS Department, CIBERSAM, ISCIII, Barcelona, Spain
[l] Section of Psychiatry, Department of Medicine and Surgery, University of Perugia, Perugia, Italy
[m] Group of Psychiatry, Mental Health and Addictions, Valld'Hebron Research Institute (VHIR); Psychiatric Genetics Unit, Valld'Hebron Research Institute (VHIR); CIBERSAM, ISCIII, Barcelona, Spain

ARTICLE INFO

Keywords:
First-episode psychosis
Emotional intelligence
Emotional processing
Neurocognition
Cognitive reserve
Negative symptoms

ABSTRACT

Emotional intelligence (EI) and neurocognition (NC) impairments are common in first-episode psychosis (FEP), yet their evolution over time remains unclear. This study identified patient profiles in EI and NC performance in FEP. 98 adult FEP patients and 128 healthy controls (HCs) were tested on clinical, functional, EI, and NC variables at baseline and two-year follow-up (FUP). A repeated-measures ANOVA compared the effects of group (patients and HCs) and time on EI. Significant EI improvements were observed in both groups. Four groups were created based on NC and EI performance at baseline and FUP in patients: impairment in NC and EI, impairment in NC only, impairment in EI only, and no impairment. At FUP, patients impaired in NC and EI showed less cognitive reserve (CR), greater negative and positive symptoms, and poorer functional outcomes. At FUP, three group trajectories were identified: (I) maintain dual impairment (II) maintain no impairment or improve, (III) maintain sole impairment or worsen. The maintain dual impairment group had the lowest levels of CR. EI and NC

* Corresponding author.
E-mail addresses: evieta@clinic.cat (E. Vieta), ctorrent@recerca.clinic.cat (C. Torrent).
[1] The first two authors contributed equally to this work and should be considered joint first authors.
[2] Co-corresponding author.
[3] PEPs group: Sergi Salmerón[b], Nestor Arbelo[b], Marta Ferrer-Quintero[h], Ana Echevarría[h], Judit Selma[i], Eva M[a] Grasa[i], Julen Marin[c], Lorea Mar[c], Concepción De-la-Cámara[g], Pedro M Ruíz-Lázaro[g], Juan Nacher [n], Carlos Cañete Nicolas[o], Anna Mané[k], Alba Toll[k], Brisa Solé[a], Aida Mallorqui[a], Josefina Castro-Fornieles[j], Inmaculada Baeza[j], Fernando Contreras[p], Pilar A. Sáiz[q], Teresa Bobes-Bascarán[q], Rafael Segarra[r], Arantzazu Zabala[r], Mauro Scala[s], Roberto Rodriguez-Jimenez[t], Judith Usall[u], Anna Butjosa[v], Edith Pomarol-Clotet[w], Maria Ángeles García-León[w], Angela Ibañez[x], Lucía Moreno-Izco[e], Vicent Balanzá-Martínez[y].

https://doi.org/10.1016/j.euroneuro.2024.05.006
Received 14 March 2024; Received in revised form 10 May 2024; Accepted 12 May 2024
Available online 15 July 2024

impairments progress differently in FEP. Greater CR may protect against comorbid EI/NC impairment. Identifying these patient characteristics could contribute to the development of personalised interventions.

1. Introduction

Emotional intelligence (EI) is conceptualized as the ability to identify, use, understand and manage emotions (Adolphs, 2009; Green and Leitman, 2008; Penn et al., 1997; Salovey et al., 2004), and is commonly measured via the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) (Mayer et al., 2002). In patients with psychotic disorders, EI is assessed via the Managing Emotions branch of the MSCEIT, which is more strongly correlated with community functioning than the three other branches and alternative measures of Social Cognition (SC) (DeTore et al., 2018). First episode psychosis (FEP) individuals have shown significant deficits in tasks exploring typical emotional responses when compared to healthy controls (HCs) (Green et al., 2012; Healey et al., 2016; Mazza et al., 2013; Thompson et al., 2012a). Conversely, other authors failed to find differences in EI between individuals with FEP and HCs (Achim et al., 2013; Basseda et al., 2012; Reske et al., 2009), although two of these studies used tasks with unknown psychometric properties: (1) the Persian version of Bar-On Emotional Quotient Inventory from an unpublished master's thesis in Basseda et al. (2012) and (2) an event-related paradigm consisting of emotion facial expressions in Reske et al. (2009). Conflicting results have also been found for the trajectory of EI impairment with evidence for the stability of EI across the phases of psychotic disorders (Green et al., 2012; Thompson et al., 2012a), as well as a decline (Healey et al., 2016; Wu et al., 2016), and others even demonstrated an improvement in chronic patients (Chen et al., 2021). Moreover, EI deficits have been identified in at-risk individuals (Thompson et al., 2012b; Van Rijn et al., 2011) suggesting they may increase vulnerability for the development of schizophrenia (Comparelli et al., 2013). These findings were based on studies using cross-sectional data limiting the generalizability of results beyond the scope of study specific objectives. Further, a dearth of longitudinal data remains; McCleery et al. (2016) reported stable SC performance in schizophrenia at 5-year follow-up, however potential limitations include the small sample size ($n = 41$) and lack of control group to compare SC stability longitudinally. Conversely, Maat et al. (2015) found that SC was poorer in patients with schizophrenia in comparison to controls at baseline and three-year follow-up, although the authors reported a high rate of attrition, and results should be interpreted in light of this limitation. Further research is required to better understand the nature and trajectory of EI deficits in FEP as they may appear early in the disease, highlighting an optimal phase of illness to provide personalized intervention and prevent worsening of EI (Healey et al., 2016).

Overall, these conflicting results may be better understood in terms of the current state of the literature. Firstly, there appears to be an overreliance on cross-sectional data meaning that causality cannot be inferred. Further longitudinal studies are thus required. Secondly, it is important to consider the heterogeniety of both samples and measurement of EI. In terms of samples, de Siqueira Rotenburg et al. (2023) identified emotion cognition subgroups in bipolar disorder, with one-third of patients showing significant longitudinal impairments, suggesting that a significant number of patients do not demonstrate this impairment. This contrasts with schizophrenia who appear to decline over time. Together, this could be related to heterogenous patient samples, further exacerbated by research focusing on more chronic patients (McCleery et al., 2016) and, in some cases, a lack of control groups. More precise characteristation of populations is warranted to gain a better insight into previously demonstrated but limited and contrasting findings. Likewise, the complexity of measuring SC which consists of many sub-domains has contributed to a lack of consensus regarding standardised measurements of SC, resulting in heterogeneous assessment methods with methodological issues (Pinkham et al., 2014).

Neurocognition (NC) impairments are also prominent in FEP and are linked to poorer functional outcomes and overall recovery (Martínez-Cengotitabengoa et al., 2012; Sánchez-Torres et al., 2018; Treen Calvo et al., 2018). Importantly, normal cognitive function is related to better clinical improvement and functional outcomes (Amoretti et al., 2018; Camprodon-Boadas et al., 2021). A range of cognitive domains appear to be affected in FEP including attention, processing speed, memory, and executive functions (Bora et al., 2018; Bora and Murray, 2014). Cognitive impairments may even be present prior to the onset of psychotic symptoms with evidence suggesting that deficits are present in childhood (Fett et al., 2020). Consequently, and similar to EI deficits, cognitive impairment may be a vulnerability factor for FEP (Bora et al., 2023). Longitudinal studies have attempted to clarify the long-term impact of these deficits. At 10-year follow-up, Zanelli et al. (2019) found that FEP patients showed a decline in overall IQ, memory, and verbal knowledge. Similarly, following patients at seven different stages over a 20-year period, those who developed schizophrenia performed more poorly than all groups at all seven assessment stages in processing speed and the ability to access general knowledge (Bonner-Jackson et al., 2010). Conversely, and following the onset of initial symptoms, patients tended to show an improvement in cognition with no evidence of decline over the 20 years (Bonner-Jackson et al., 2010). Findings may have been limited by the heterogeneity of the groups studied, namely schizophrenia, other psychotic disorders, and non-psychotic disorders. Also, no control group was included in the assessment to compare against normal age-related cognitive decline. Further mixed results were also reported between 2 to 20 years following hospitalisation: mild to moderate cognitive decline was observed in verbal memory, visual memory, attention, processing speed, and abstraction-executive function, yet improvement in verbal knowledge and stable verbal fluency was also identified (Fett et al., 2020). Moreover, deficits in both NC and SC have been associated with psychosocial difficulties in FEP (Stouten et al., 2017). As such, further research is required to improve our understanding of both EI and NC impairments across the illness trajectory following a FEP, which may be further complicated by the conflicting results reported regarding the complex relationship between SC and NC in FEP and their role in functioning (Fett et al., 2011; Griffiths et al., 2021; Ohmuro et al., 2016). Doing so may be of clinical importance for designing interventions to improve functional outcomes in this population.

1.1. Aims of the study

The present study aims to: (1) explore differences in EI between FEP patients and HCs at baseline and two-year follow-up; (2) establish group characteristics based on EI and NC performance at baseline and two-year follow-up; and (3) examine the changes among the groups at both stages of evaluation.

2. Experimental procedures

2.1. Participants

The sample comprised a total of 98 FEP patients and 128 healthy controls (HCs) who were recruited as part of the 'Phenotype-Genotype Interaction: Application of a Predictive Model in First Psychotic Episodes' (PEPs Project based on its Spanish acronym) (Bernardo et al., 2013, 2019), a collaborative project between various members of the Spanish Research Network on Mental Health (CIBERSAM) (Salagre et al., 2019).

The current study used the following inclusion criteria: (1) aged

between 18 and 35 years of age at the time of first evaluation; (2) < 12-month history of psychotic symptoms; (3) fluent in Spanish; and (4) provide written informed consent. The exclusion criteria were as follows: (1) intellectual disability according to DSM-IV-TR criteria (American Psychiatric Association, 2000); (2) history of head trauma with loss of consciousness; (3) medical disease that may significantly affect mental health. The patients were matched with HCs by age (± 10%), sex, and parental socioeconomic status (SES) (± 1 level). The same exclusion criteria were used for HCs but included the presence of a current or past psychotic disorder or major depression and having a first degree relative with psychotic disorder history.

To ensure sample homogeneity, only adult patients with non-affective FEP were included given the evidence that both clinical course and functional outcome present specific characteristics depending on the subgroup. At two-year follow-up and according to DSM-IV-TR, non-affective FEP diagnosis was considered as: schizophrenia, schizophreniform, schizoaffective disorders, and other psychoses not otherwise specified. Only FEP patients who had less than 6% missing data in neuropsychological tests at baseline and follow-up were included in the present study. Supplementary Fig. 1 shows the flowchart for the selection of the 98 non-affective FEP and 128 HCs.

The PEPs Project was approved by the Clinical Research Ethics Committee of all participating centres and was carried out in accordance with the ethical principles of the Declaration of Helsinki and Good Clinical Practice. All participants who met inclusion criteria provided written informed consent prior to their inclusion in the study.

2.2. Materials

2.2.1. Clinical and sociodemographic data

Clinical and sociodemographic data were collected for all participants. Parental socioeconomic status (SES) was obtained using Hollinghead's Two-Factor Index of Social Position (Hollingshead and Redlich, 1958). Pharmacological treatment was measured by chlorpromazine equivalents (CPZ) based on international consensus (Gardner et al., 2010). For the duration of untreated psychosis (DUP) the number of days between the first appearance of psychotic symptoms and the first time receiving appropriate treatment for psychosis was calculated. Substance use habits were also obtained using the European Addiction Severity Index (EuropASI) (Kokkevi and Hartgers, 1995) and participants with current substance abuse comorbid diagnosis were not excluded in order to ensure a more representative FEP sample.

Clinical diagnoses were determined according to the Structured Clinical Interview for DSM (SCID-I-II) (First et al., 1997) for DSM-IV criteria. To take into account any possible changes across time, as well as to ensure diagnostic stability, diagnoses were based on the data obtained at the 2-year-follow-up visit for all participants who completed the study in its entirety.

A psychopathology assessment was also carried out using the Spanish version of scales chosen based on their relevance to FEP. The Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987; Peralta and Cuesta, 1994) was used to identify positive and negative symptoms and the Montgomery-Asberg Depression Rating Scale (MADRS) (Lobo et al., 2002; Montgomery and Asberg, 1979) to measure depressive symptomatology. The Clinical Global Impression Scale (CGI) was used to assess global illness severity (Guy, 1976). On each scale higher scores indicate greater severity of symptoms.

2.2.2. Functional assessment

To assess psychosocial functioning, the Functioning Assessment Short Test (FAST) (Rosa et al., 2007) and the Global Assessment of Functioning (GAF) (Endicott et al., 1976) were administered. The FAST scale contains 24 items that assess impairment or disability across the following six areas of functioning: autonomy, occupational functioning, cognitive functioning, financial issues, interpersonal relationships, and leisure time. The FAST ranges in non-affective FEP patients were as follows: 0-9 (No impairment); 10-19 (Minimal impairment); 20-34 (Mild impairment); 35-45 (Moderate impairment); 46-72 (Severe impairment) (Amoretti et al., 2021a). Thus, higher scores indicate poorer functioning.

The GAF aims to rate the severity of psychopathology and includes an overall global score of patients' current state by measuring the degree of mental illness in terms of psychological, social, and occupational functioning (Aas, 2010). Lower scores indicate a greater severity of impaired functioning.

2.2.3. Premorbid adjustment and cognitive reserve

Premorbid adjustment was assessed retrospectively using the Premorbid Adjustment Scale (PAS) (Cannon-Spoor et al., 1982). This scale evaluates the degree of achievement of developmental goals prior to the onset of psychotic symptoms. In this study, data was collected with reference to the periods of childhood and adolescence as these were the sole parts of the scale administered to participants due to the age of symptom onset. Higher scores indicate poorer premorbid adjustment.

Cognitive reserve (CR) is widely accepted as the ability of a brain to cope with brain pathology in order to minimize symptoms (Stern, 2002). To measure it, estimated premorbid intellectual functioning (IQ), education and lifetime participation in leisure, as well as social and physical activities, were calculated (Amoretti et al., 2016, 2018, 2019; Anaya et al., 2016). Premorbid IQ was evaluated with the Vocabulary subtest of the Weschler Adult Intelligence Scale (WAIS III) (Weschsler, 1997). Education was measured by registering the total number of years participants completed in education, as well as parents' educational level, and lifetime school performance was evaluated using the scholastic performance domain of the PAS scale (Cannon-Spoor et al., 1982. The FAST scale was used to measure lifetime participation in leisure, social, and physical activities. Higher scores correspond to better performance.

2.2.4. Neuropsychological assessment

For this study, the two cognitive clusters identified by Amoretti et al. (2021b) were used: (1) the first cluster (56.1%) with mild to moderate cognitive impairments in processing speed, verbal learning, working memory and verbal fluency and (2) the second one (43.9%) with relatively intact cognition (results within the typical limits in all scores on standardized tests).

These groups were formed based on the results of an extensive neuropsychological assessment that was conducted in the second month of evaluation to ensure clinical stability of patients included in the study. This assessment was repeated at the two-year follow-up visit. Importantly, data imputation was conducted for all data that contained less than 6% and 2% at baseline and two-year follow-up as the algorithm used for clustering cannot be implemented on missing values. The following cognitive domains were investigated via the neuropsychological test battery: (1) processing speed with the Trail Making Test, form A (TMT-A) (Reitan and Wolfson, 1993); (2) verbal learning and memory with the Verbal Learning Test Spain Complutense for adults (TAVEC) (Benedet, 1998); (3) working memory via the Digit Span Subtest and the Letter-Number (LN) Sequencing Subtest of the WAIS-III (Weschsler, 1997); (4) executive functions with the Stroop Color and Word Test (SCWT)(Golden and Freshwater, 1978); (5) Controlled Oral Word Association Test composed by phonemic verbal fluency (FAS), and semantic fluency (animal naming) (Loonstra et al., 2010). All scores were standardized with respect to the subject's age and/or educational level according to standardized normative data found in the test manual. Higher t-test scores indicate better performance in all cognitive domains.

2.2.5. Emotional intelligence

The Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) (Mayer et al., 2002) is comprised of 141 items and 8 subtests that test overall emotional intelligence and four components (branches) of EI which include perceiving emotions, understanding emotions, managing

emotions, and facilitating thought. For the present study, only the managing emotions branch was used as it is the SC domain added in the MATRICS Consensus Cognitive Battery (MCCB) (Nuechterlein et al., 2008). The MSCEIT Managing Emotions branch includes two tasks (Emotional Management and Emotional Relations) that assess social and emotion management in terms of regulating self-emotions and identifying emotion regulation in others. A total of eight vignettes that describe difficult social situations are read aloud to the participants who are then offered a selection of four different ways a person may respond to said situation. Each choice reflects varying degrees of emotional reactivity, and they also vary in their level of adaptability. The participant is then offered a list of four possible reactions and is required to rate the effectiveness of each of the four actions using a five-point scale ranging from very ineffective to very effective. In the branch, higher scores correspond to better performance.

2.3. Statistical analysis

This study was carried out in four specific phases:

1- Sociodemographic differences between patients and HCs:

At baseline and two-year follow-up, we explored differences between patients and HCs using chi-squared for categorical variables as a form of descriptive analysis. Unpaired t-tests for normally distributed variables and Mann-Whitney U tests for non-normal data were performed to examine any group differences. To assess whether differences between patients and HCs who were evaluated/not evaluated at follow-up, chi-square and Student's t-test were used.

2- Differences in EI performance at baseline and two-year follow-up between patients and HCs

We conducted a linear mixed model to analyse the effect of time and group (patients or HCs) on EI and overall time*group interaction.

3- NC and EI grouping in patients, and its performance at baseline and follow-up:

We employed a cross-sectional approach to group patients based on their performance in both NC and EI at baseline and two-year follow-up. Grouping:

For NC we used a machine learning technique called Partition Around Medoids (explained in Amoretti et al., 2021b to identify two distinct cognitive clusters: cognitively impaired or intact patients. Cluster analysis was applied using R (Version 3.5.3) and analyzed data from various neuropsychological tests (TMT-A, TAVEC, LN, SCWT, FAS, Animal Naming) administered both at baseline and follow-up. Several steps were taken: a) cognitive scores were transformed into standardized t-scores; b) missing data (missing cognitive data $<$ 6% and $<$2% at baseline and two-year follow-up) was imputed using the Multivariate Imputation by Chained equations algorithm (Van Burren and Groothuis-Oudshoorn, 2011), as the clustering algorithm cannot be used if missing data are present; c) determined the optimal number of clusters based on the average silhouette width, which measures how well objects are grouped (ranging from -1 for poor clustering to 1 for good clustering). In this way, the optimal number of clusters is selected based on the number of subgroups with the highest value for the average silhouette width.

EI categorization did not involve a clustering method as NC. Instead, we relied on pre-defined qualitative cut-off scores from the MSCEIT manual to classify participants into two groups: EI Impaired, which included individuals with an EI score below 90, suggesting a need for potential improvement or development; and EI Intact, comprising participants scoring above 91, indicating well-developed EI, even though might be low/high average, competent or represent strength to the person.

Performance at baseline and follow-up:

The NC and EI categories were then combined to create four groups for performance evaluation both at baseline and follow-up: Impairment in both NC and EI; Impairment in NC only; Impairment in EI only and No Impairment. These groups were used for subsequent analyses at both time points. To assess differences between these four groups in clinical, sociodemographic, and functional variables, one-way ANOVAs were conducted at baseline and follow-up, controlling for CPZ equivalents. Post-hoc Tukey's HSD tests were employed for further comparisons when significant ANOVA results were obtained. When significant differences were found, the output of the Tukey post-hoc tests were referred to.

4- Patients' trajectories based on EI and NC performance

Finally, at both evaluation stages, we decided to explore the different groups according to the EI/NC performance, identifying the following three groups: (I) maintain dual impairment (II) maintain no impairment or improve, (III) maintain sole impairment or worsen. This grouping strategy responds primarily to the limitation of the sample size of the individual groups, but it also allows to identify meaningful trajectories with potential clinical implications:

Group I. Maintain dual impairment: These participants exhibited ongoing impairments in both NC and EI throughout the study period. This group represents the most concerning trajectory, as it indicates persistent challenges in both cognitive and emotional functioning. Individuals in this group may require comprehensive interventions that address both cognitive and emotional deficits.

Group II. Maintain no impairment or improve: These participants either maintained healthy NC and EI levels or showed improvement in these domains over time. This group represents the most favorable trajectory, as it indicates stable or positive change in both cognitive and emotional functioning. Individuals in this group may benefit from preventive measures or interventions that focus on maintaining and enhancing their cognitive and emotional aspects.

Group III. Maintain sole impairment or worsen: These participants either continued to experience an impairment in either NC or EI, or their performance worsened in these areas over time. Despite the mixed nature of their trajectories, individuals in this group are categorized together due to their shared need for targeted interventions. They all present with ongoing challenges in either cognitive or emotional functioning, indicating a need for specific support to address these deficits. While they may not exhibit the same level of severity as those in Group I, they remain susceptible to further decline if their impairments are not addressed.

Data was analysed using SPSS version 26. Significance level was set at $p < 0.05$.

3. Results

3.1. Sociodemographic differences between patients and HCs

A total of 98 patients with FEP and 128 HCs were included in the present study and also completed the 2-year follow-up. 68% of patients ($n = 67$) were male with a mean age of 25.83±5.16 years (age at onset of psychosis = 25.15±5.89). In terms of substance use, 67.6% ($n = 75$) used tobacco, 55% ($n = 61$) consumed alcohol, and 45% ($n = 50$) were cannabis users. The mean dose of CPZ equivalents was 580.61 ± 416.99 and the mean DUP was 115.71 ± 131.31 days (approximately 16 weeks). There were no differences between patients and HCs in terms of age ($p = 0.399$), sex ($p = 0.342$) and SES ($p = 0.101$).

The follow-up sample of the FEP group ($n = 98$) did not differ from

the sample without follow-up data ($n = 146$) in terms of sociodemographic, functional, and EI performance, except for SES ($p = 0.0017$), CGI ($p = 0.004$) and specific domains of the neurocognitive evaluation including TMT-A ($p = 0.040$), TAVEC ($p = 0.045$), LN ($p = 0.018$). Patients without follow-up data had lower SES, less clinical severity, and worse neurocognitive performance. Similarly, HCs assessed at follow-up ($n = 98$) showed no differences compared to the total sample of baseline HCs ($n = 96$) in terms of sociodemographic and functional outcomes (see Supplementary Table 1). However, those assessed only at baseline showed worse processing speed (TMT-A, $p = 0.041$) and better semantic fluency (animals, $p = 0.032$).

3.2. Differences in EI performance at baseline and two-year follow-up between patients and HCs

Patients had lower EI scores than HCs at both baseline and at two-year follow-up. The results from the linear mixed model revealed that improvements were observed in both groups from baseline to follow-up, but no significant interaction were found between time and group (see Table 1).

3.3. NC and EI grouping in patients, and its performance at baseline and follow-up

Four groups were created at baseline based on NC and EI performance: impairment in NC and EI ($n = 31$, 31.6%), impairment in NC only ($n = 21$, 21.4%), impairment in EI only ($n = 17$, 17.4%), and no impairment ($n = 29$, 29.6%). A summary of baseline characteristics and the differences between each group can be found in Table 2. Overall, the group with no impairment had a higher SES than the impairment in NC only group ($p = 0.015$). Initially, DUP was found to be significantly higher in the impairment in both NC and EI group ($p = 0.020$) than all other groups, but this result was no longer supported by the Tukey's post-hoc test. The impairment in both NC and EI and the impairment in NC only had lower CR than the impairment in EI only group and the no impairment group ($p < 0.001$). Impairment in both NC and EI showed higher negative symptoms than the no impairment group ($p = 0.042$).

At two-year follow-up, patients were categorized in the same four groups: impairment in both NC and EI ($n = 17$, 17.4%), impairment in NC only ($n = 12$, 12.2%), impairment in EI only ($n = 25$, 25.5%), and no impairment ($n = 44$, 44.9%). Sociodemographic, clinical characteristics, and psychosocial functioning at baseline and at 2-year follow-up can be found in Table 3. The impairment in NC only had a greater dose of antipsychotic treatment than the no impairment group ($p = 0.010$) at baseline but this was not significant at two-year follow-up ($p = 0.206$). The impairment in both NC and EI demonstrated lower level of CR than the impairment in EI only and no impairment groups ($p = 0.002$). At baseline, the impairment in NC only showed higher severity of negative symptoms than the no impairment group ($p = 0.017$). At two-year follow-up, the impairment in both NC and EI group had more severe positive ($p = 0.041$) and negative symptoms ($p = 0.008$) than the impairment in EI only and no impairment group. Similarly, at two-year follow-up the impairment in both NC and EI had greater overall symptom severity than the no impairment group ($p = 0.030$). Finally, at two-year follow-up the impairment in both NC and EI group showed greater functional impairment than the no impairment group ($p = 0.006$).

3.4. Patients' trajectories based on EI and NC performance

Three groups were identified to describe the course of the disease and labelled accordingly as (I) maintain dual impairment ($n = 11$) (II) maintain no impairment or improve ($n = 57$), (III) maintain sole impairment or worsen ($n = 30$). Groups are displayed in Fig. 1.

These results show evidence of patients with persistent impairment in both areas at baseline and two-year follow-up as 35.5% of the sample with dual impairment at baseline continue with these difficulties at two-year follow-up. On the other hand, almost 23% of patients with impairment in both NC and EI at baseline showed full improvement at two-year follow-up. Similarly, a large majority of patients who showed impairment in one of the two areas at baseline demonstrated a tendency towards improvement as they had no impairment at two-year follow-up (39.5%). Conversely, at two-year follow-up, 60.5% of patients with one of the two areas affected continue to demonstrate this deficit or worsen showing signs of impairment in both domains.

It was found that the maintain dual impairment group had the lowest levels of CR in comparison to the maintain sole impairment or worsen group ($p = 0.007$) and maintain no impairment or improve ($p = 0.002$). No other significant differences were found. The demographic and clinical characteristics of these trajectories as well as their statistical characteristics are presented in Table 4.

4. Discussion

Three core findings emerged in the present study. Firstly, FEP patients demonstrated poorer EI performance than HCs at baseline and two-year follow-up. Although both groups showed an improvement from baseline to follow-up, a notable difference between patients and HCs was observed, with the former performing worse. Secondly, patients with dual impairment (EI and NC) exhibited specific deficits which varied at baseline and two-year follow-up and may represent potential risk factors for these patients. Thirdly, 35.5% of patients with dual impairment at baseline, remain with this deficit at two-year follow-up, as well as the lowest CR in the whole sample.

Previous findings indicated that EI deficits are present in FEP (Amminger et al., 2012; Bediou et al., 2007; Comparelli et al., 2013; Edwards et al., 2001; Herbener et al., 2005; Mazza et al., 2013). Our results supported this literature and showed a poorer evolution of FEP patients' EI performance at baseline and two-year follow-up. Nevertheless, the observed improvements are in line with previous research highlighting improvements in FEP patients over time (Haring et al., 2017; Hill et al., 2004; Watson et al., 2022). EI is affected not only in FEP patients, but also in prodromal stages (Green et al., 2012), and even in high-risk population (Addington et al., 2008; Mondragón-Maya et al., 2017), highlighting the importance of assessing this domain.

Based on the two groups of cognition (NC impaired and NC non-impaired), and to assess differences between groups according to EI, we generated four groups (impairment in both NC and EI, impairment in NC only, impairment in EI only, and no impairment). At baseline, the group with impairment in both NC and EI presented greater negative symptoms and lower CR than the no impairment group. A complex relationship is commonly reported between negative symptoms and cognition (Harvey et al., 2006; Hughes et al., 2003) and SC (Pelletier-Baldelli and Holt, 2020; Puig et al., 2017), as related yet independent constructs. Nevertheless, there are a limited number of studies including

Table 1
Group differences in FEP patients' and HCs'emotional intelligence performance.

	Patients	Healthy controls	Time		Subject		Time x Subject	
			F	Sig.	F	Sig.	F	Sig.
Baseline	91.87±12.00	100.68±11.98	5.318	**0.022**	58.254	**<0.001**	0.001	0.980
2-year follow-up	94.55±12.64	103.80±12.08						

Abbreviations: EI= Emotional intelligence. Significant differences ($p < 0.05$) marked in bold.

Table 2
Sociodemographic, clinical characteristics and psychosocial functioning at baseline among baseline groups.

		Impairment in both NC and EI (n = 31) [1]	Impairment in NC only (n = 21) [2]	Impairment in EI only (n = 17) [3]	No impairment (n = 29) [4]	F	p	Post hoc (Tukey's HSD)
Sociodemographic variables								
Sex: Male N(%)		20 (65)	14 (67)	12 (71)	20 (69)	χ^2=1.007	0.800	-
Age (M±SD)		24.13±4.28	27.14±6.00	25.82±5.25	26.79±5.14	1.952	0.127	-
SES (%)	High	10 (32)	2 (10)	7 (41)	7 (24)	χ^2=24.881	**0.015**	[2]<[4]*
	Medium-High	1 (3)	0 (0)	2 (12)	8 (28)			
	Medium	6 (20)	3 (14)	2 (12)	6 (21)			
	Medium-Low	10 (32)	13 (62)	6 (35)	7 (24)			
	Low	4 (13)	3 (14)	0 (0)	1 (3)			
	Missing							
DUP		182.26±181.44	85.75±86.35	82.88±96.38	93.50±101.33	3.457	**0.020**	-
CPZ		669.45±453.70	596.58±469.96	636.64±420.68	402.53±273.56	2.204	0.093	
Tobacco: Yes N (%)		21 (68)	14 (67)	8 (53)	19 (66)	χ^2=1.18	0.757	-
Cannabis: Yes N (%)		14 (45)	10 (48)	4 (24)	11 (38)	χ^2=2.828	0.419	-
Alcohol: Yes N (%)		16 (31)	11 (52)	5 (29)	19 (66)	χ^2=5.601	0.133	-
PAS		49.30±23.40	47.70±20.29	41.69±17.28	36.00±22.06	2.110	0.105	-
Cognitive reserve		69.72±11.72	71.94±8.44	81.25±11.86	81.95±8.55	9.731	**<0.001**	[1]<[3,4]**, [2]<[3,4]*
Clinical variables								
PANSS positive		19.19±7.94	19.86±9.52	16.71±6.85	16.17±7.09	1.293	0.281	-
PANSS negative		21.00±7.27	20.62±6.95	17.53±7.20	16.48±6.02	2.846	**0.042**	[1]>[4]*
PANSS general		39.32±11.17	36.71±14.03	33.00±11.86	37.07±11.25	1.025	0.385	-
PANSS total		79.52±22.70	77.19±27.78	67.24±23.04	69.72±20.68	1.504	0.219	-
MADRS		12.97±10.31	9.05±8.48	11.12±9.88	11.97±7.70	0.806	0.494	-
CGI		4.42±1.34	4.43±0.68	4.29±1.16	4.38±0.86	0.065	0.978	-
Functional variables								
GAF		48.77±19.13	57.14±18.51	54.18±17.19	55.97±18.00	1.142	0.336	-
FAST		31.29±15.28	28.14±14.03	26.82±14.00	23.07±14.86	1.594	0.196	-

Abbreviations: CGI=Clinical Global Impression Scale; CPZ= Chlorpromazine equivalents; DUP= Duration of untreated psychosis; FAST=Functioning Assessment Short Test; GAF= Global Assessment of Functioning; HSD= Honestly Significant Difference; M=Mean; MADRS= Montgomery-Asberg Depression Rating Scale; PANSS= Positive and Negative Symptom Scale; PAS= Premorbid Adjustment Scale; SD= Standard Deviation. Significant differences ($p < 0.05$) marked in bold. *$p < 0.05$, **$p < 0.001$.

specific EI assessment: it has been reported that negative symptoms are significantly related to EI and NC and contribute to functional outcome more than positive or depressive symptoms (Lin et al., 2013). Additionally, the no impairment group had higher SES than the impairment in NC only group. This is in line with a recent study concluding that lower SES has a more negative impact on cognitive performance in psychotic patients compared to healthy controls (Czepielewski et al., 2022). At two-year follow-up, the impairment in both NC and EI group had lower CR and more severe negative symptoms than the impairment in EI only and the no impairment groups; in previous research FEP patients with higher CR have presented lower symptomatology and better NC (Amoretti et al., 2016, 2018). Moreover, this group also had a higher PANSS positive and total score and greater impaired functioning than the no impairment group supporting research that NC (Allott et al., 2011; Green et al., 2000; Santesteban-Echarri et al., 2017), SC (Griffiths et al., 2021), and CR (González-Ortega et al., 2020) are associated with poorer functional outcomes in FEP. Consequently, our results underline the possible importance of a multidimensional approach including NC, EI, CR and negative symptoms in the evaluation of FEP patients. Altogether, one plausible line of thought might be the relationship between these factors, as follows: FEP patients may accumulate lower CR, due to less access to related activities in the context of lower SES (study, languages, culture, among others). Lower CR is related to greater negative symptomatology and impairment in cognition in FEP (Amoretti et al., 2016, 2018). Importantly, CR and NC have also been associated with functioning outcomes, with SC mediating the relationship (González-Ortega et al., 2020), therefore reiterating the need to explore, NC, EI, and CR in further detail. More studies are needed to unravel the complexity of this relationship.

Three groups were formed based on their NC and EI performance from baseline to 2-year follow-up: (I) maintain dual impairment (II) maintain no impairment or improve, (III) maintain sole impairment or worsen. The maintain dual impairment patients represented the group with the lowest level of CR in the present sample with the highest levels associated with the maintain no impairment or improve group. Considering the concept of CR, two potential explanations capture the complexity of these multifaceted findings. CR is defined as the ability to cope with brain damage to delay the onset of clinical, cognitive, and functional manifestations of pathology and minimize their expression (Stern, 2002). Previous research suggests that higher CR is associated with lower disease severity, defined as better cognitive performance, lower symptomatology, and better psychosocial functioning (Amoretti et al., 2016; Amoretti et al., 2021c; Amoretti and Ramos-Quiroga, 2021; Barnett et al., 2006; Camprodon-Boadas et al., 2021; de la Serna et al., 2013). Higher CR is thus considered as a protective factor and has been related to better prognosis. As such, our results suggest that higher CR maybe a protective factor following a FEP. Based on this idea, patients with low CR and dual impairment in NC and EI, could benefit from a prevention program that focuses on measuring and enhancing CR, NC, and EI in FEP. In fact, a study protocol for a randomized controlled trial that aims to enhance CR in high genetic risk populations has recently been published (de la Serna et al., 2021). Identifying patients with these profile characteristics could help to develop individualized treatment methods.

One alternative explanation for these observations is plausible. Individuals exhibiting the lowest levels of NC and EI performance might be hindered in their ability to accumulate CR during their development, which has already been discussed in depth as part of the neurodevelopmental theory of schizophrenia. This theory proposes that SZ is characterized by alterations beginning in the earliest stages of development (Rapoport et al., 2012). Consequently, difficulties are expected in acquiring cognitive abilities during development (Bora, 2015), which subsequently impact everyday functioning. Additionally, the underlying pathology itself can limit the accumulation of CR. This limitation could

Table 3
Sociodemographic, clinical characteristics and psychosocial functioning at baseline and 2-year follow-up among follow-up groups

	Impairment in both NC and EI (n = 17) [1]	Impairment in NC only (n = 12) [2]	Impairment in EI only (n = 25) [3]	No impairment (n = 44) [4]	F	p	Post hoc (Tukey's HSD)
Sociodemographic variables							
Sex: Male *N*(%)	10 (59)	10 (83)	17 (68)	29 (66)	χ^2=2.002	0.572	-
Age (M±SD)	27.61±5.59	27.77±3.85	28.24±4.60	27.70±5.72	0.071	0.975	-
DUP	157.94±127.25	124.54±122.61	136.45±177.16	84.27±100.81	1.603	0.194	-
CPZ BL	483.58±380.26	837.54±411.06	707.88±438.79	467.98±376.94	4.020	**0.010**	[2]>[4]*
CPZ FUP	321.40±366.13	223.08±303.19	218.23±262.11	161.59±202.77	1.552	0.206	
Tobacco: Yes *N* (%)	8 (47)	6 (50)	13 (52)	25 (57)	χ^2=9.784	0.134	-
Cannabis: Yes *N* (%)	3 (18)	1 (8)	3 (12)	5 (11)	χ^2=10.448	0.107	-
Alcohol: Yes *N* (%)	7 (41)	4 (33)	16 (64)	26 (60)	χ^2=12.106	0.060	-
PAS	52.80±21.96	50.23±22.32	41.43±16.20	39.38±22.84	2.006	0.119	-
Cognitive reserve	67.50±11.96	73.38±9.85	76.96±9.43	79.10±11.21	5.259	**0.002**	[1]<[3,4]**
Clinical variables							
PANSS positive BL	17.78±7.80	21.69±8.08	17.24±7.03	17.80±8.38	1.019	0.388	
PANSS positive FUP	12.57±5.37	12.42±5.70	10.44±4.41	9.44±3.05	2.872	**0.041**	-
PANSS negative BL	19.00±7.33	23.85±7.36	20.08±7.08	17.14±6.15	3.545	**0.017**	[2]>[4]*
PANSS negative FUP	18.43±6.11	16.92±6.40	13.00±5.05	13.14±5.84	4.231	**0.008**	[1]>[3,4]*
PANSS general BL	36.11±11.03	44.54±11.77	35.52±11.84	36.86±12.61	1.822	0.148	
PANSS general FUP	29.36±9.43	28.25±11.43	25.12±9.01	24.37±6.91	1.596	0.196	-
PANSS total BL	72.89±23.46	90.08±23.39	72.84±23.15	71.80±23.46	2.190	0.094	
PANSS total FUP	60.36±18.88	57.58±21.04	48.56±17.50	46.95±13.79	3.130	**0.030**	[1]>[4]*
MADRS BL	10.67±8.02	12.00±10.65	14.00±10.12	10.59±8.41	0.830	0.480	
MADRS FUP	8.29±8.53	6.25±4.43	5.68±6.20	5.14±6.07	0.878	0.456	-
CGI BL	4.28±1.23	3.92±1.19	4.44±1.00	4.50±0.93	1.116	0.347	
CGI FUP	2.94±1.83	2.62±1.56	2.60±1.32	2.59±1.21	0.299	0.826	-
Functional variables							
GAF BL	57.56±19.75	56.92±10.52	52.40±16.62	52.73±20.84	0.456	0.714	
GAF FUP	67.92±10.36	72.00±12.42	76.57±11.81	72.93±12.93	1.420	0.242	-
FAST BL	28.28±15.07	33.15±14.01	26.56±13.44	26.30±15.58	0.779	0.508	
FAST FUP	27.64±16.07	25.92±15.10	17.40±14.58	14.53±12.28	4.393	**0.006**	[1]>[4]*

Abbreviations: BL= Baseline; CGI=Clinical Global Impression Scale; CPZ= Chlorpromazine equivalents; DUP= Duration of untreated psychosis; FAST=Functioning Assessment Short Test; FUp = Follow-up; GAF= Global Assessment of Functioning; HSD= Honestly Significant Difference; M=Mean; MADRS= Montgomery-Asberg Depression Rating Scale; PANSS= Positive and Negative Symptom Scale; PAS= Premorbid Adjustment Scale; SD= Standard Deviation. Significant differences ($p < 0.05$) marked in bold. *$p < 0.05$, **$p < 0.001$.

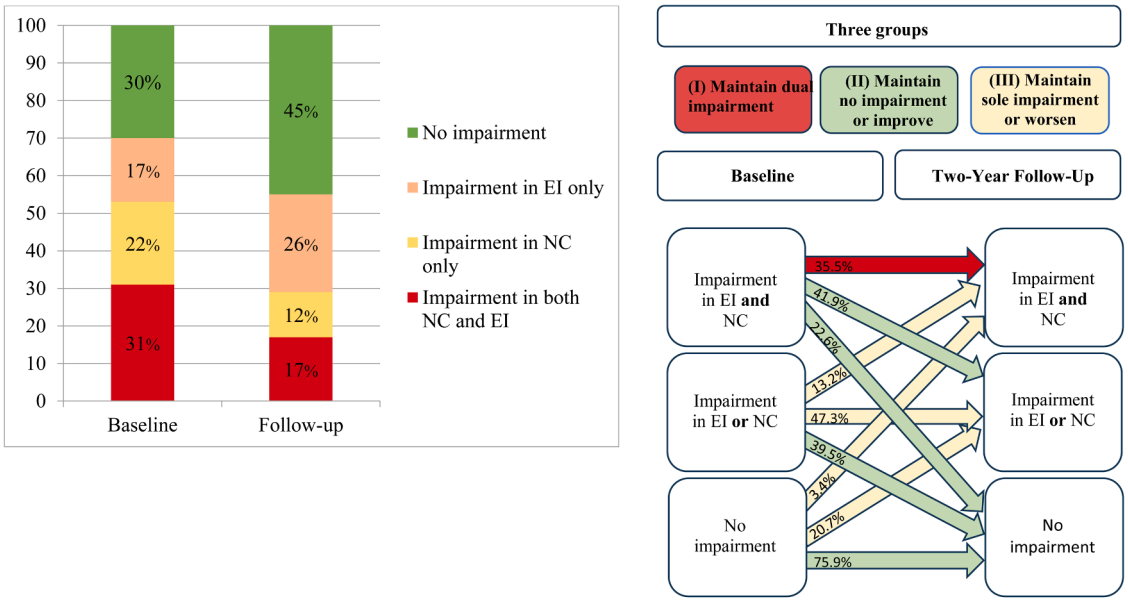
manifest in difficulties attaining education, maintaining social relationships, or engaging in physical/leisure activities. Therefore, the causal direction may not be unidirectional, with lower CR solely leading to poorer NC and EI. Instead, a reciprocal relationship is plausible, suggesting that interventions targeting EI and NC could be a viable strategy to enhance aspects that are intimately related to CR. This, in turn, could initiate a positive feedback loop, ultimately leading to improved overall functioning and quality of life.

Our results should be interpreted alongside some limitations. Firstly, our sample was small when distributing the different groups, with some groups having less than 20 participants, thus potentially reducing statistical power. Future research with larger sample sizes is needed. Secondly, EI was solely assessed with one branch of MSCEIT - Managing Emotions branch – as it is the measurement included in the MATRICS Consensus Cognitive Battery. Thirdly a limitation in studies researching CR in psychiatric populations is the lack of consensus in measuring CR as a construct. Accordingly, the Cognitive Reserve Assessment Scale in Health (CRASH) was created by Amoretti et al. (2019). This scale measures CR in patients with severe mental illness and should be used in future studies. Fourth, as in all observational studies, medication was a potential confounder (Ilzarbe and Vieta, 2023). Finally, results were not controlled for substance misuse. Nevertheless, the study design is a major strength that counterbalances these limitations. This naturalistic, multicentric, longitudinal study monitored different variables of interest longitudinally and thus increases the generalizability of results in the studied population. We discovered important clinical findings and highlight several potential areas for future research and opportunities to inform individualized patient interventions.

To conclude, we added to the literature of adults with a FEP by identifying four groups according to NC and EI impairment level. This is an important contribution given that there appear to be strong links between NC and EI, yet we demonstrate that they seem to follow different paths in the disease course. Moreover, we highlight the importance of considering CR in this population as the persistent course of impairment in both NC and EI showed reduced CR in comparison to the no impairment group. Future research should look to explore these groups with increased sample sizes longitudinally to decipher their impact on the long-term functional outcomes and the possible role of CR which appears to act as a protective factor after a FEP.

Author Contributions

Conceptualization: DC, MFF, GM, AMST, AGP, EV, AMA, CT, MB, SA; Data curation and formal analysis: DC, MFF, GM, MSN, CT, SA; Writing - original draft : DC, MFF, GM, MSN, EV, AMA, CT, MB, SA; Writing - review/editing: DC, MFF, GM, AMST, MSN, RP, AL, AGP, RP (Rocío



Abbreviations: Emotional intelligence (EI) and neurocognition (NC)

Fig. 1. Group profiles and longitudinal change pattern of groups.
Abbreviations: Emotional intelligence (EI) and neurocognition (NC)

Table 4
Sociodemographic, clinical characteristics and psychosocial functioning at baseline among longitudinal change pattern of groups.

	[I] Maintain dual impairment ($n = 11$)	[II] Maintain no impairment or improve ($n = 57$)	[III] Maintain sole impairment or worsen ($n = 30$)	F	*p*	Post hoc (Tukey's HSD)
Sociodemographic variables						
Sex: Male *N*(%)	6 (55)	38 (67)	22 (73)	χ^2=1.321	0.517	-
Age (M±SD)	24.55±5.05	25.37±5.33	27.27±4.79	1.742	0.181	-
DUP	178.80±149.34	113.44±146.77	99.76±91.81	1.359	0.262	-
CPZ	556.42±383.17	559.11±438.39	604.24±399.44	0.112	0.894	
Tobacco: Yes *N* (%)	6 (55)	37 (65)	20 (67)	χ^2=0.538	0.764	-
Cannabis: Yes *N* (%)	4 (36)	24 (62)	11 (37)	χ^2=0.304	0.859	-
Alcohol: Yes *N* (%)	6 (55)	30 (53)	15 (50)	χ^2=0.086	0.958	-
PAS	57.67±23.45	40.54±21.57	44.71±20.35	2.538	0.085	-
Cognitive reserve	64.80±12.49	77.41±11.16	76.81±9.93	6.291	**0.003**	[I]<[II,III]*
Clinical variables						
PANSS positive	18.18±8.16	17.37±7.97	19.17±7.93	0.503	0.607	-
PANSS negative	20.45±7.90	18.16±6.69	20.00±7.37	0.946	0.392	-
PANSS general	35.73±11.49	37.07±12.09	37.33±12.30	0.073	0.929	-
PANSS total	74.36±24.69	72.60±22.83	76.50±25.08	0.267	0.766	-
MADRS	10.00±8.17	11.02±9.19	13.00±9.37	0.631	0.534	-
CGI	4.45±1.13	4.39±1.13	4.37±0.85	0.028	0.972	-
Functional variables						
GAF	50.45±18.50	53.54±20.20	54.97±14.80	0.240	0.787	-
FAST	29.91±17.20	26.95±15.15	27.37±13.63	0.181	0.834	-

Abbreviations: CGI=Clinical Global Impression Scale; CPZ= Chlorpromazine equivalents; DUP= Duration of untreated psychosis; FAST=Functioning Assessment Short Test; GAF= Global Assessment of Functioning; HSD= Honestly Significant Difference; M=Mean; MADRS= Montgomery-Asberg Depression Rating Scale; PANSS= Positive and Negative Symptom Scale; PAS= Premorbid Adjustment Scale; SD= Standard Deviation. Significant differences ($p < 0.05$) marked in bold. *$p < 0.05$, **$p < 0.001$.

Panadero), AR, EV, EdlS, AT, AMA, CT, AT, GM (Giulia Menculini), JARQ, MJC, MB, SA. Supervision: EV, CT, MB, SA. All authors contributed to and approved the final manuscript.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: EV has received grants and served as consultant, advisor or CME speaker for the following entities: AB-Biotics, AbbVie, Adamed, Angelini, Biogen, Biohaven, Boehringer-Ingelheim, Celon Pharma, Compass, Dainippon Sumitomo Pharma, Ethypharm, Ferrer, Gedeon Richter, GH Research, Glaxo-Smith Kline, HMNC, Idorsia, Janssen, Lundbeck, Medincell, Merck, Novartis, Orion Corporation, Organon, Otsuka, Roche, Rovi, Sage, Sanofi-Aventis, Sunovion, Takeda, and Viatris, outside the submitted work.A. Tortorella received research support and travel grants from Lundbeck and Angelini (unrelated to the present work).

G. Menculini received travel grants from Angelini and Janssen.

J.A. Ramos-Quiroga was on the speakers' bureau and/or acted as consultant for Eli-Lilly, Janssen-Cilag, Novartis, Shire, Takeda, Bial, Shionogui, Lundbeck, Almirall, Braingaze, Sincrolab, Medice and Rubió, Raffo in the last 5 years. He also received travel awards (air tickets + hotel) for taking part in psychiatric meetings from Janssen-Cilag, Rubió, Shire, Takeda, Shionogui, Bial, Medice and Eli- Lilly. The Department of Psychiatry chaired by him received unrestricted educational and research support from the following companies in the last 5 years: Eli-Lilly, Lundbeck, Janssen- Cilag, Actelion, Shire, Ferrer, Oryzon, Roche, Psious, and Rubió.

M. Bernardo has been a consultant for, received grant/research support and honoraria from, and been on the speakers/advisory board of ABBiotics, Adamed, Angelini, Casen Recordati, Janssen-Cilag, Menarini, Rovi and Takeda

A. Gonzalez-Pinto has received grants and served as consultant, advisor or CME speaker for the following entities: Janssen-Cilag, Lundbeck, Otsuka, Alter, Angelini, Novartis, Rovi, Takeda, the Spanish Ministry of Science and Innovation (CIBERSAM), the Ministry of Science (Carlos III Institute), the Basque Government, and the European Framework Program of Research.

V. Balanzá-Martínez has received honoraria from Angelini, unrelated to the present work.

Dr. R. Rodriguez-Jimenez has been a consultant for, spoken in activities of, or received grants from: Instituto de Salud Carlos III, Fondo de Investigación Sanitaria (FIS), Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Madrid Regional Government (S2010/BMD-2422 AGES; S2017/BMD-3740), JanssenCilag, Lundbeck, Otsuka, Pfizer, Ferrer, Juste, Takeda, Exeltis, Casen-Recordati, Angelini, Rovi.

S. Salmeron has received medical education and training courses support from rovi, rubio, Janseen-Cilag, and Casen Recordati and travel support from Rovi.

A. Roldán has served as advisor or speaker for the companies Otsuka and Angelini (unrelated to the present work).

P. A. Sáiz has been a consultant to and/or has received honoraria or grants from Adamed, Alter, CIBERSAM, Ethypharm Digital Therapy, European Commission, Government of the Principality of Asturias, Instituto de Salud Carlos III, Janssen-Cilag, Lundbeck, Otsuka, Pfizer, Plan Nacional Sobre Drogas and Servier.

I. Baeza has received honoraria and travel support from Angelini, Otsuka-Lundbeck and Janssen, grants from Spanish Ministry of Health, ISCIII (FIS18/0242/FIS21/0391), co-financed by the European Union, National Drugs Plan (2022I053) and Alicia Koplowitz Foundation.

The rest of authors report no biomedical financial interests or potential conflicts of interest.

Acknowledgements

We are extremely grateful to all participants.

This study is part of a coordinated-multicentre Project, funded by the Ministerio de Economía y Competitividad (PI08/0208; PI11/00325; PI14/00612), Instituto de Salud Carlos III – Fondo Europeo de Desarrollo Regional. Unión Europea. Una manera de hacer Europa, Centro de Investigación Biomédica en Red de salud Mental, CIBERSAM, by the CERCA Programme / Generalitat de Catalunya AND Secretaria d'Universitats i Recerca del Departament d'Economia I Coneixement (2021 SGR 01120). Departament de Salut de la Generalitat de Catalunya, en la convocatòria corresponent a l'any 2017 de concessió de subvencions del Pla Estratègic de Recerca i Innovació en Salut (PERIS) 2016-2020, modalitat Projectes de recerca orientats a l'atenció primària, amb el codi d'expedient SLT006/17/00345. This work was supported by La Marató-TV3 Foundation grants 202234-30 (to E. Vieta), 202234-32 (to S. Amoretti).

S. Amoretti has been supported by Sara Borrell doctoral programme (CD20/00177) and M-AES mobility fellowship (MV22/00002), from the Instituto de Salud Carlos III (ISCIII), and co-funded by European Social Fund "Investing in your future".

MFF received the support of "*Contratos predoctorales de formación en investigación en salud*" (PFIS22) (FI22/00185) from the *Instituto de Salud Carlos III (ISCIII)* with European funds from the Recovery, Transformation and Resilience Plan, by virtue of the Resolution of the Directorate of the Carlos III Health Institute, O.A., M.P. of December 14, 2022, granting Predoctoral Research Training Contracts in Health (PFIS Contracts). Funded by the European Union – tGenerationEU.

E. Vieta thanks the support of the Spanish Ministry of Science, Innovation and Universities (PI18/00805; PI21/00787) integrated into the Plan Nacional de I+D+I y cofinanciado por el ISCIII-Subdirección General de Evaluación y el Fondo Europeo de Desarrollo Regional (FEDER); CIBERSAM; and the Comissionat per a Universitats i Recerca del DIUE de la Generalitat de Catalunya to the Bipolar Disorders Group (2021 SGR 1358) and the project SLT006/17/00357, from PERIS 2016-2020 (Departament de Salut). CERCA Programme/Generalitat de Catalunya.

A. González-Pinto thanks the support of the Spanish Ministry of Science, Innovation and Universities PI21/00713, PI18/01055 integrated into the Plan Nacional de I+D+I y cofinanciado por el ISCIII-Subdirección General de Evaluación y el Fondo Europeo de Desarrollo Regional (FEDER); CIBERSAM; and the Basque Government 2022111054.

C. Torrent thanks the support of the Spanish Ministry of Science, Innovation and Universities (PI20/00344) integrated into the Plan Nacional de I+D+I y cofinanciado por el ISCIII-Subdirección General de Evaluación y el Fondo Europeo de Desarrollo Regional (FEDER).

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.euroneuro.2024.05.006.

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