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How does neighbourhood socio-economic status affect the interrelationships between functioning dimensions in first episode of psychosis? A network analysis approach

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ABSTRACT

The links between psychosis and socio-economic disadvantage have been widely studied. No previous study has analysed the interrelationships and mutual influences between functioning dimensions in first episode of psychosis (FEP) according to their neighbourhood household income, using a multidimensional and transdiagnostic perspective. 170 patients and 129 controls, participants in an observational study (AGES-CM), comprised the study sample. The *WHO Disability Assessment Schedule* (WHODAS 2.0) was used to assess functioning, whereas participants' postcodes were used to obtain the average household income for each neighbourhood, collected by the Spanish National Statistics Institute (INE). Network analyses were conducted with the aim of defining the interrelationships between the different dimensions of functioning according to the neighbourhood household income. Our results show that lower neighbourhood socioeconomic level is associated with lower functioning in patients with FEP. Moreover, our findings suggest that "household responsibilities" plays a central role in the disability of patients who live in low-income neighbourhoods, whereas "dealing with strangers" is the most important node in the network of patients who live in high-income neighbourhoods. These results could help to personalize treatments, by allowing the identification of potential functioning areas to be prioritized in the treatment of FEP according to the patient's neighbourhood characteristics.

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1. Introduction

The distribution of income is a key determinant of population health (Kawachi and Kennedy, 1997). The links between psychosis and socio-economic disadvantage have been identified across diverse cultural, social, and demographic contexts (Sweeney et al., 2015).

Neighbourhood socioeconomic status, defined as the social standing of a group (American Psychological Association, 2021), has received special attention due to its contribution to the increased risk of poor general and mental health outcomes (Drukker and van Os, 2003), whose influence appears even after controlling for individual socioeconomic status (Drukker et al., 2004; Lemstra et al., 2006). This is particularly important in the study of psychosis, since individuals who subsequently develop schizophrenia seem to be more likely to live in deprived areas (Jongsma et al., 2020; O'Donoghue et al., 2016).

There is an ongoing debate about the direction of the association between both variables (Burns and Esterhuizen, 2008; Eaton et al., 2019; Hastings et al., 2019; March et al., 2008; O'Donoghue et al., 2016). It is unclear if the development of a psychotic disorder could be a consequence of the neighbourhood level (Eaton et al., 2019; Krabbendam, 2005) or, conversely, people with psychotic disorders drift into more deprived areas (O'Donoghue et al., 2016) as a result of their difficulties in obtaining and maintaining gainful employment, which leads them to live in more disadvantaged neighbourhoods (Hastings et al., 2019). Be that as it may, many researchers have hypothesised about causal mechanisms potentially underlying an increased risk for psychosis in disadvantaged neighbourhoods. Among them, we can highlight the role of biological risk factors such as exposure to infections (Harrison et al., 2001), pollutants, or toxins (March et al., 2008), drug use (Krabbendam, 2005), unhealthy lifestyle (Drukker and van Os, 2003), and nutritional deprivation (Hastings et al., 2019). On the other hand, psychosocial mechanisms as social isolation (Krabbendam, 2005; March et al., 2008; Topor et al., 2019), exposure to crime (Wilson et al., 2016), lack of educational opportunities (Hastings et al., 2019; Steele et al., 2006; Wilson et al., 2016), and stress (Harrison et al., 2001; Wilson et al., 2016) have been proposed.

These results seem to sustain the idea that psychotic patients seem to be more sensitive to a particular environmental risk factor (van Os et al., 2010). In an attempt to explain it, the vulnerability stress model was proposed (Nuechterlein and Dawson, 1984). Within this framework, vulnerability is conceptualised as factors, residing within the person, that make individuals susceptible (e.g. genetic factors), whereas stressors are from the environment, such as social stress, which would include, for example, unemployment, low socioeconomic status, or stigma (Cheng et al., 2016). Psychotic patients are still thought to be more susceptible to stress compared with healthy individuals. However, whether this increased sensitivity is due to their hampered coping skills, their cognitive difficulties, or their inadequate biologic stress response systems remains to be elucidated (Gispen-de Wied and Jansen, 2002).

In recent years, social scientists and social epidemiologists have argued that the contexts that affect health are constructed through the dynamic and bidirectional interactions of both body and environmental variations (Hastings et al., 2019). In the same way, the functioning of a person in a given functional domain could be described as the result of a complex interaction between the health condition and environmental and personal factors (WHO, 2013).

Network analysis represents an important innovation in the study of the interplay among variables (Galderisi et al., 2018). Even though direct influences of one symptom on another are routinely observed in clinical practice, in classical psychometric approaches, such direct influences are not modelled, and symptoms are treated as passive psychometric indicators of a latent variable (Isvoranu et al., 2017). For example, in traditional methods such as regression analysis and principal component analysis, in which statistical models are obtained that can bring answers by adjustments and data reduction (Leme et al., 2020) or structural equations models, that do not allow simultaneous testing of reciprocal influences among cross-sectional data (Galderisi et al., 2018; Kline, 2012). However, the network approach conceptualizes symptoms as parts of a complex system, forming a network of interacting or even reinforcing elements (Borsboom and Cramer, 2013). From this perspective, the study of their interaction would be central to progress in understanding and treating mental disorders (Isvoranu et al., 2017). This methodology has been previously applied in order to explore the interactions between psychotic symptoms (Bak et al., 2016; Isvoranu et al., 2017; van Rooijen et al., 2017), their influence in overall functioning (Chang et al., 2019; Galderisi et al, 2018, 2020), and the environmental impact on psychotic symptomatology (Isvoranu et al., 2016). However, to the best of our knowledge, no previous study has specifically analysed the interrelationships and mutual influences between functioning dimensions in first episode of psychosis according to their neighbourhood household income using a multidimensional and transdiagnostic perspective. Improving knowledge about it is needed to provide a comprehensive perspective of the psychosocial difficulties associated with psychosis spectrum disorders in order to allow for better intervention targeting and to suggest guidance for further research (Switaj et al., 2012). This is particularly important during the few years after the FEP, since previous longitudinal studies have shown that psychosocial disability at illness onset is strongly predictive of disability many years later (Griffiths et al., 2019). This fact is represented by the concept of "critical period", which stipulates that the first few years after the FEP would be a window of opportunity for intervention (Birchwood et al., 1998) that can positively impact long-term outcome (Díaz-Caneja et al., 2015; Lambert et al., 2006).

We hypothesised that 1) patients who live in low-income neighbourhoods would not only have higher overall disability, but also a different pattern of affected areas of functioning than those who live in high-income neighbourhoods; 2) the network characteristics (such as network structure or overall level of connectivity) would be different between patients and controls; and 3) we posited that the association between economic level of neighbourhood context and disability would differ in patients and controls, with patients being more vulnerable to its effects.

2. Materials and methods

2.1. Study sample

All the study subjects were participants in an observational study of patients with first episode of psychosis (AGES-CM), carried out at the seven largest University Hospitals in the Community of Madrid, Spain. The study protocol was approved by the appropriate institutional ethics committee. 170 patients and 129 controls provided informed consent from February 2013 to May 2019. The patients should meet the following criteria to be included in this study: a) age between 7 and 40 years; b) experiencing their first episode of psychosis (per DSM-IV-TR or DSM-5 criteria) with a total lifetime duration of positive psychotic symptoms lower than 24 months. Exclusion criteria were: a) meeting diagnostic criteria for another current Axis-I mental disorder (except substance use disorder); b) meeting diagnostic criteria for intellectual disability; c) history of neurodevelopmental disorders or head injury with loss of consciousness; and d) pregnancy. In healthy controls, inclusion criteria were: a) age between 7 and 40 years; and b) written informed consent. Exclusion criteria were: a) meeting diagnostic criteria for a current Axis-I mental disorder; b) meeting diagnostic criteria for intellectual disability, history of neurodevelopmental disorders, or head injury with loss of consciousness; c) having a family history of a psychotic disorder in first or second degree relative; and d) pregnancy. Patients and healthy controls were matched for age and gender.

2.2. Measures

2.2.1. Sociodemographic variables

Sociodemographic information was collected from participants and medical records. It included: age (years), gender, marital status (single, steady partner, or divorced), and occupational status (unemployed, employed, student, or pensioned). In addition, the parental socioeconomic status (SES) was assessed following the Hollingshead's Index of Social Position (Hollingshead, 1957), a common system that is based upon parental occupation and educational levels (i.e., years of education and highest educational degree of the parent with the highest level) (Fraguas et al., 2017). As in previous studies (Hur et al., 2015), parental SES was preferred to individual SES, since most of our sample were not yet financially independent from their families.

2.2.2. Neighbourhood income

In line with previous research (Bhavsar et al., 2018; Drukker et al., 2006), the home address at the first contact with psychiatric services was established as the participant's neighbourhood of residence. Our participants had been living in the stated addresses for a mean of 9.39 years and just the 27.1% of them had recently moved to another house. Information about 104 postal codes were compiled, in which a median of 34,882.5 persons live.

Postal codes were used to obtain the average household income for each neighbourhood, collected by the Spanish National Statistics Institute (INE) in 2015. This indicator is the result of the collaboration that the INE has been carrying out with the Tax Agency. For its development, two components have been taken into account: 1) the average annual net income, estimated by the Tax Agency from the joint use of the withholding or annual information models and the annual income tax return; and 2) the number of households recorded in the register.

In our study, both patients and controls were divided into two groups, according to the median neighbourhood-level household income (M = 31,913.21 €). This cut-off point nearly matches with the mean household income in the Community of Madrid, Spain (Mean = 31,243 €).

2.2.3. Disability

The *WHO Disability Assessment Schedule* (WHODAS 2.0) (World Health Organization, 2015) was used to assess functioning. It was designed for the evaluation of health and disability at population level or in clinical practice, providing a common metric of the impact of any health condition in terms of functioning. This instrument captures the level of functioning within the last 30 days in six domains of life: Cognition (learning and concentrating difficulties), Mobility (walking and standing difficulties), Self-care (washing and getting dressed difficulties), Getting along with others (problems with maintaining a friendship and dealing with strangers), Life activities (domestic responsibilities and work/school performance), and Participation (difficulties in joining in community activities, participating in society and stigmatization). The 12 items were assessed in a 5-point Likert-scale (from 0 = "no disability" to 5 = "extreme disability"). For the purposes of this work, we included the 12 items in our network as a measure of different dimensions of functioning. Its internal consistency, measured by Cronbach's alpha, was 0.90 for the total scale in our sample.

2.2.4. Clinical measures

The *Positive and Negative Syndrome Scale* (PANSS) (Kay et al., 1987) was used to assess symptom severity in a 7 point Likert-scale which represents increasing levels of psychopathology (from 1 = "absent" to 7 = "extreme"). The total score as well as the Positive, Negative, and General Psychopathology dimensions were calculated. The PANSS scale has shown a very satisfactory internal consistency in our sample. Cronbach's alpha coefficients for each dimension were: 0.86 for Positive Scale, 0.91 for Negative Scale, and 0.89 for General Scale.

The *Hamilton Depression Rating Scale* (Hamilton, 1960) was used as a measure of depression severity. The scale contains 17 items, distributed in a 3- or 5-point Likert-scale. Global score was calculated. In the present study, internal consistency, measured by Cronbach's alpha, was 0.82 for the total scale.

The *Young Mania Rating Scale* (Young et al., 1978) was applied in order to evaluate the intensity of manic symptoms. It is composed by 11 items, rated in a 5-point Likert-scale. The total score was calculated. In our sample, its internal consistency was $\alpha = 0.79$.

2.2.5. Other neighbourhood-level characteristics

The *Medical Research Council Sociodemographic Schedule* (Mallett, 1997) was used to assess a number of potential indicators of social disadvantage at neighbourhood-level (Morgan et al., 2009), such as urbanicity, ethnicity, social capital, crime frequency, or crime concern. It includes 39 items, distributed in a 5-point Likert-scale (from 1 = totally disagree to 5 = totally agree).

2.3. Statistical analysis

Frequency analysis were applied in order to describe the characteristics of the sample. To test differences in categorical variables, chi-squared tests were carried out across the income groups, using Cramer's V as an effect size estimate. According to Cohen (1988), Cramer's values of 0.10 implies low effect size, whereas 0.30 denotes medium effect size, and 0.50 high effect size. To test differences in continuous variables, t-test and ANOVA tests were used. With the purpose of stablishing the effect size, Cohen's d and Cohen's f were calculated, respectively. Cohen's d values are interpreted as 0.20 = small, 0.50 = medium, and 0.80 = high, whereas these cut-off points are 0.10, 0.25, and 0.40 in the case of Cohen's f (Cohen, 1988).

Network analysis was conducted with the aim of defining the interrelationships between the different dimensions of functioning. To this end, areas of functioning are represented as nodes, whereas edges indicate pathways on which nodes can affect each other after controlling for all other variables in the network (Epskamp, 2017). The items "walking around", "washing the whole body," and "getting dressed" were removed due to no variability. Taking into account that our data were ordinal, we estimated the networks using the Gaussian Graphical Model (Costantini et al., 2015). The regularization method "least absolute shrinkage and selection operator (LASSO)" was applied in order to limit the number of spurious connections (Epskamp et al., 2018a) in combination with the Extended Bayesian Information Criterion (EBIC) under γ value of 0.25 (Hevey, 2018).

In order to assess the importance of each node within the network structure, three centrality indices were computed: node strength (the sum of the absolute edge weights connected to each node), closeness (the inverse of the sum of the distances from one node to the others), and betweenness (which quantifies how often one node is in the shortest paths between other nodes) (Epskamp and Fried, 2018). The higher the values, the more important the nodes are in the network. According to the network theories (Borsboom and Cramer, 2013), central nodes were hypothesised to be responsible for maintaining the network, as they are involved in stronger interactions or in the majority of interactions that constitute the network. The deactivation of central nodes should also deactivate the interactions in which those nodes are involved. For this reason, it has often been proposed that these nodes can provide valuable psychotherapeutic targets because they may accelerate the deactivation of the network and consequently catalyse treatments (Castro et al., 2019).

To test the accuracy and stability of our network parameters, we estimated confidence intervals on the edge-weights under non-parametric bootstrapping (Epskamp et al., 2018a) and the *Correlation Stability Coefficient*, which represents the maximum proportion of cases that can be dropped to retain a correlation of at least 0.7 with the original centrality indices. It should not be below 0.25 (Epskamp and Fried, 2018).

Network Comparison Test (NCT) was applied to compare network structures between the four groups. This method uses permutation testing to evaluate three assumptions: invariant network structure (the structure of the network is completely identical across subpopulations), invariant edge strength (the strength of a specific edge is the same across groups), and invariant global strength (the overall level of connectivity is equal across groups) (Borkulo et al., 2017).

Sensitivity analysis have been carried out in order to control the influence of the following variables: urbanicity, ethnicity, social capital, crime frequency or crime concern at neighbourhood-level, as well as recently moved, level of education, marital status and occupational status (results under request).

Descriptive analyses were carried out using SPSS software, version 25 (IBM Corp, 2017), whereas network analyses were conducted with JASP (JASP Team, 2020) and R Core Software (R Core Team, 2019), packages: *qgraph,* (Epskamp et al., 2012), *bootnet* (Epskamp et al., 2018b), and *NetworkComparisonTest* (Borkulo et al., 2017).

3. Results

Our sample was composed of 170 patients and 129 controls. Patients showed a higher likelihood of being single (χ^2 (6) = 13.872; p = .031) and unemployed (χ^2 (6) = 53.899; p=<.001), having lower functioning (F (2, 436) = 54.899; $p < .001$), and having higher scores in psychotic (F (3, 293) = 75.361; $p < .001$), depressive (F (3, 293) = 30.318; $p < .001$), and manic symptoms (F (3, 292) = 13.705; $p < .001$) than healthy controls. Within patients, those who live in low-income neighbourhoods had higher rates of divorce (χ^2 (2) = 8.003; p = .018) and unemployment (χ^2 (2) = 9.394; p = .009) than those who live in high-income neighbourhoods. Patients living in low-income neighbourhoods also showed higher disability (t (158,458) = 2.598; p = .010), particularly in cognitive functioning, self-care, and household responsibilities (Table 1). The influence of neighbourhood household income on overall functioning emerged even after controlling for parental socioeconomic status (B = −0.119; β = -0.201; t (2, 160) = -2.411; p = .017). No significant differences appeared between controls who live in low-income neighbourhoods and controls who live in high-income neighbourhoods. According to the WHODAS total score, patients who live in low-income neighbourhoods would show the greatest functional disability, followed by patients who live in high-income neighbourhoods and both control groups.

The four estimated networks are shown in Fig. 1. Positive and negative correlations were found, ranging from 0 (between "household responsibilities" and "concentrating" in patients who live in low-income neighbourhoods) to 0.813 (between "standing" and "joining in the community activities" in controls who live in high-income neighbourhoods). While in patients almost all correlations are positive, in both control groups there are negative relationships between nodes.

Table 2 shows the centrality indices for each network. According to its centrality measures, "household responsibilities" is the most central node in patients who live in low-income neighbourhoods, whereas "dealing with strangers" plays a prominent role in patients who live in high-income neighbourhoods. Similarly, in controls who live in high-income neighbourhoods, "maintaining a friendship" display a high centrality, while in controls who live in low-income neighbourhoods, "work performance" is the most central one.

No significant differences were found in the edge-weights across the four groups since the bootstrapped confidence interval of most edges overlap (Fig. 2). Concerning the stability of the centrality indices, in the group of patients who live in high-income neighbourhoods, closeness and strength indices are stable, since almost 30% of cases could be dropped and it would still retain a correlation of 0.7 with the original centrality indices. Regarding node strength in the group of patients who live in low-income neighbourhoods, more than 30% of the cases could also be dropped. However, closeness and betweenness indices perform worse. In both groups of controls, the stability of the three centrality indices drops steeply.

Pairwise network comparisons revealed that global strength was significantly different between the group of patients who live in low-income neighbourhoods and those controls who live in low-income neighbourhoods (S-test = 8.1010; $p < .001$), patients who live in high-income neighbourhoods and controls who live in low-income neighbourhoods (S-test = 6.5269; p = .018), and patients who live in low-income neighbourhoods and controls who live in high-income neighbourhoods (S-test = 6.4043; $p < .001$). Significant differences were also found in network structures across patients who live in low-income neighbourhoods and controls who live in low-income neighbourhoods (M-test = 1.1077; p = .002) and patients who live in high-income neighbourhoods and controls who live in low-income neighbourhoods (M-test = 1.3264; p = .006).

4. Discussion

The conditions in which individuals live and work have gained increasing attention due to their role in perpetuating health inequity (Burns et al., 2014). Low socioeconomic status has been associated with lower functioning, social difficulties, and unmet needs (Hui et al., 2019; Samele et al., 2001; Topor et al., 2019). This study aimed to shed light on the way in which different functioning dimensions are interrelated according to the neighbourhood household income in patients with first episode of psychosis.

According to our results, the networks belonging to both control groups are more densely connected in comparison with the patient's ones. Although there is an increasing evidence that various patient groups have stronger network connections between psychopathological variables compared to healthy controls or patient groups in remission (Cramer et al., 2016; Santos et al., 2017), other studies have found the opposite results (Beard et al., 2016; Bos et al., 2018). A number of possible explanations have been proposed, related for example to the loss of complexity hypothesis associated with disease, which postulates that the reduced complexity reflects the underlying changes in the organization of the system (Vaillancourt and Newell, 2002). From a systemic perspective, this complexity would reflect the system's ability to adapt to the constantly changing environment, often impaired in patients (Yang and Tsai, 2013).

Our analysis shows that lower neighbourhood household income is associated not only with lower functioning in patients with first episode of psychosis, but also with an increased length of their difficulties. Patients living in low-income neighbourhoods seem to have higher difficulties regarding household responsibilities, washing their whole body, learning, and concentrating. The last two dimensions could be related to the fact that people who live in low-income neighbourhoods appear to have a lack of educational opportunities and high chronic stress exposure (Vargas et al., 2020), as discussed further. However, against our initial hypothesis, these differences do not appear when comparing the network structure across both patient groups. A possible explanation could be related to the fact that the impact of the illness could unify the way in which different functioning domains are interrelated. Another possible explanation could be that our study was carried out in patients with FEP, so these patterns could change as the illness progresses. Although the interrelationships seem to be similar between patient groups, the role that each functioning dimension plays could be different. Our results appear to indicate that "household responsibilities" plays a central role in the disability of patients who live in low-income neighbourhoods, whereas "dealing with strangers" is the most central node in the network of patients who live in high-income neighbourhoods. This later pattern has also been found between both control groups, in which the patterns of mutual influence seem to be similar, but the importance of each node within the network differs. In controls who live in low-income neighbourhoods, "work performance" display a high centrality, while "maintaining a friendship" is the most central node in the network of controls who live in high-income

Table 1
Demographic and clinical characteristics of the study sample.

Variables	Study sample (n = 299)	Patients living in high-income neighbourhoods (n = 83)	Patients living in low-income neighbourhoods (n = 87)	Controls living in high-income neighbourhoods (n = 65)	Controls living in low-income neighbourhoods (n = 64)	Comparisons across the four groups		Comparisons across both patient groups	
						χ^2/F *(p)*	Cramer's V/ Cohen's *f*	χ^2/t *(p)*	Cramer's *V*/ Cohen's *d*
Gender n, %						6.448 (.092)		1.153 (.283)	
Female	118 (39.5)	25 (30.1)	33 (37.9)	28 (43.1)	32 (50.0)				
Male	181 (60.5)	58 (69.9)	54 (62.1)	37 (56.9)	32 (50.0)				
Age (years), Mean (SD)	25.02 (6.101)	23.8 (6.386)	24.91 (6.003)	26.77 (6.495)	25 (5.077)	2.964 (.032)*	.841	1.171 (.243)	
Marital status, n (%)						13.872 (.031)*	.153	8.003 (.018)*	.218
Single	259 (87.8)	79 (96.3)	72 (83.7)	56 (88.9)	52 (81.3)				
Steady partner	28 (9.5)	3 (3.7)	10 (11.69	4 (6.3)	11 (17.2)				
Divorced	8 (2.7)	–	4 (4.7)	3 (4.8)	1 (1.6)				
Income, Mean (SD)	37677.73 (14221.50)	47529.27 (14467.69)	27481.33 (2245.36)	48405.94 (13424.92)	27886.38 (2508.57)	102.38 (<.001)*	.700	12.482 (<.001)*	1.409
Parental Socioeconomic Status, Mean (SD)	41.56 (18.256)	42.54 (18.924)	34.09 (17.969)	50.63 (15.471)	39.17 (17.433)	10.795 (<.001)*	.337	2.923 (.004)*	.463
Occupational status, n (%)						53.899 (<.001)*	.306	9.394 (.009)*	.243
Employed	98 (34)	9 (11.7)	19 (23.2)	36 (55.4)	34 (53.1)				
Unemployed	98 (34)	30 (39.0)	41 (50)	11 (16.9)	16 (25.0)				
Student	92 (31.9)	38 (49.4)	22 (26.8)	18 (27.7)	14 (21.9)				
Diagnosis, n (%)								4.045 (.775)	
Schizophrenia	38 (12.7)	20 (24.1)	18 (20.7)	–	–				
Schizophreniform disorder	33 (11.0)	14 (16.9)	19 (21.8)	–	–				
Delusional disorder	3 (1.0)	1 (1.2)	2 (2.3)	–	–				
Brief psychotic disorder	23 (7.7)	10 (12.0)	13 (14.9)	–	–				
Schizoaffective disorder	1 (7.7)	–	1 (1.1)	–	–				
Psychosis NOS	51 (17.1)	25 (30.1)	26 (26.9)	–	–				
Bipolar disorder with psychotic features	17 (5.7)	10 (12.0)	7 (8.0)	–	–				
Major depressive disorder with psychotic features	4 (1.3)	3 (3.6)	1 (1.1)	–	–				
WHODAS, Mean (SD)	19.07 (8.153)	21.31 (7.357)	24.69 (9.411)	13.23 (2.12)	13.72 (2.957)	54.869 (<.001)*	.800	2.598 (.010)*	.401
Standing for long periods	1.47 (.838)	1.65 (1.017)	1.69 (.845)	1.18 (.497)	1.23 (.707)	8.041 (<.001)*	.961	.302 (.763)	
Household responsibilities	1.54 (.930)	1.63 (.984)	2.05 (1.112)	1.11 (.359)	1.17 (.579)	19.888 (<.001)*	.911	2.594 (.010)*	.403
Learning a new task	1.58 (.983)	1.67 (1.001)	2.25 (1.154)	1.09 (.458)	1.08 (.37)	31.704 (<.001)*	.868	3.431 (.001)*	.507
Joining in community activities	1.82 (1.2)	2.17 (1.205)	2.56 (1.356)	1.11 (.562)	1.13 (.454)	38.320 (<.001)*	.846	1.951 (.053)	
Emotionally affected	1.98 (1.271)	2.43 (1.202)	2.8 (1.412)	1.09 (.341)	1.23 (.636)	49.159 (<.001)*	.815	1.794 (.075)	
Concentrating	1.79 (1.077)	1.94 (1.086)	2.42 (1.209)	1.23 (.553)	1.31 (.732)	25.388 (<.001)*	.891	2.727 (.007)*	.409
Walking	1.33 (.785)	1.43 (.94)	1.68 (.946)	1.02 (.124)	1.08 (.447)	13.108 (<.001)*	.364	1.678 (.095)	
Washing	1.13 (.472)	1.13 (.488)	1.32 (.694)	1 (.0)	1.02 (.125)	7.898 (<.001)*	.962	2.004 (.047)*	.294
Getting dressed	1.08 (.34)	1.07 (.262)	1.2 (.552)	1 (.0)	1.02 (.125)	5.779 (.001)*	.971	1.907 (.059)	

(*continued on next page*)

Table 1 (*continued*)

Variables	Study sample (n = 299)	Patients living in high-income neighbourhoods (n = 83)	Patients living in low-income neighbourhoods (n = 87)	Controls living in high-income neighbourhoods (n = 65)	Controls living in low-income neighbourhoods (n = 64)	Comparisons across the four groups		Comparisons across both patient groups	
						χ^2/F (*p*)	Cramer's V/ Cohen's *f*	χ^2/t (*p*)	Cramer's V/ Cohen's *d*
Dealing with strangers	1.78 (1.126)	2.22 (1.279)	2.16 (1.204)	1.2 (.592)	1.28 (.701)	20.917 (<.001)*	.907	-.272 (.786)	
Maintaining a friendship	1.63 (1.051)	1.92 (1.191)	2.14 (1.197)	1.12 (.484)	1.11 (.441)	23.321 (<.001)*	.898	1.224 (.223)	
Work/School	1.81 (1.243)	2.23 (1.29)	2.54 (1.46)	1.09 (.292)	1.08 (.414)	37.082 (<.001)*	.849	1.423 (.157)	
How much did these difficulties interfere?	2.11 (1.275)	2.66 (1.271)	2.82 (1.265)	1.23 (.58)	1.33 (.741)	47.354 (<.001)*	.820	.822 (.412)	
How many days?	10.43 (12.493)	14.17 (12.592)	18.28 (12.311)	3.08 (7.154)	2.83 (7.621)	40.192 (<.001)*	.840	2.118 (.036)*	.327
Days unable to carry out usual activities	4.6 (9.212)	5.76 (9.66)	10.36 (11.988)	.08 (.322)	.25 (1.309)	26.853 (<.001)*	.884	2.719 (.007)*	.423
Days reducing usual activities	6.93 (10.873)	9.12 (10.947)	14.25 (12.753)	.4 (1.309)	1.28 (5.397)	9654.5 (<.001)*	.849	2.766 (.006)*	.426
PANSS, Mean (SD)	50.72 (22.391)	62.92 (21.872)	64.16 (21.683)	33.36 (4.111)	34.20 (7.465)	75.361 (<.001)*	.751	.372 (.710)	
PANSS positive subscale, Mean (SD)	11.41 (6.491)	14.02 (7.396)	17.56 (7.842)	7.38 (1.558)	7.25 (.713)	43.204 (<.001)*	.833	.891 (.374)	
PANSS negative subscale, Mean (SD)	13.24 (7.407)	17.11 (7.075)	31.60 (11.763)	7.77 (1.294)	7.91 (1.858)	66.611 (<.001)*	.771	.391 (.696)	
PANSS general subscale, Mean (SD)	26.06 (11.102)	31.78 (10.85)	31.60 (11.763)	18.22 (3.010)	19.05 (5.706)	50.569 (<.001)*	.811	-.102 (.919)	
HAMILTON, Mean (SD)	5.68 (5.931)	8.05 (5.679)	8.34 (7.003)	2.28 (2.672)	2.52 (3.309)	30.318 (<.001)*	.874	.299 (.765)	
YOUNG, Mean (SD)	3.23 (6.004)	4.79 (6.148)	5.30 (8.323)	1.02 (2.134)	.64 (1.16)	13.705 (<.001)*	.936	.450 (.654)	

Abbreviations: WHODAS, World Health Organization Disability Assessment Schedule; PANSS, Positive and Negative Syndrome Scale; HAMILTON, Hamilton Depression Rating Scale; YOUNG, Young Mania Rating Scale.

neighbourhoods. Impaired everyday functioning seems to be a complex phenomenon, since there are many factors that contribute to adequate outcomes (Harvey and Strassnig, 2012). Nevertheless, previous studies have identified a relationship between lower SES and poorer performance on daily activities in patients with psychotic spectrum disorders (Chen et al., 2018). On the other hand, there is a growing body of knowledge about the links between income and social functioning in people with severe mental health problems. Higher income neighbourhoods frequently have communities with stronger social cohesion (O'Donoghue et al., 2016). Likewise, other authors have suggested that incomes would be associated with the opportunities to participate in a social life, to have reciprocal relationships, and to be part of the community (Topor et al., 2019). These patterns of centrality are in line with the Maslow's Hierarchy of Needs (Maslow, 1943), which offers an interesting framework for comprehending the effects of socioeconomic inequalities. According to Maslow's theory, individuals with lower socioeconomic status more often struggle to satisfy lower-level needs, such as housing problems, problems meeting ends financially, problems with job security, safety issues, and lower social cohesion. Meanwhile, those with higher levels of income would have more basic needs satisfied and therefore end up higher in the hierarchy (van Lenthe et al., 2015), such as belongingness needs.

In addition, our analysis shows that neighbourhood household income affects controls who live in low-income neighbourhoods and patients who live in low-income neighbourhoods differently. These differences appear not only when comparing network structure, but also when comparing global strength between groups. These results could be related to the presence of psychotic disorder, which would make patients more vulnerable to the environment effects, as has been pointed out in previous studies (van Os et al., 2010). Interestingly enough, we didn't find these differences among both high-income neighbourhoods' groups, which could be explained by the fact that material resources available would enable them to address functioning problems. The relationship between socioeconomic factors and health outcomes are likely to be significant in determining the use of mental health and social services required to sustain complex needs (Sweeney et al., 2015). In other words, advantaged communities tend to have access to social services and higher participation in broader economic and cultural opportunities.

Our results could have clinical and research implications. Firstly, our results are in line with the fact that experiencing a first psychotic episode is associated with having specific functioning problems regardless of neighbourhood income level. However, our results also support that the socioeconomic level of the living place might be related to their level of disability, since patients living in higher income neighbourhoods reported higher functioning and these differences would appear even in countries with public mental healthcare systems. These findings are in line with previous literature, which suggest that certain local level

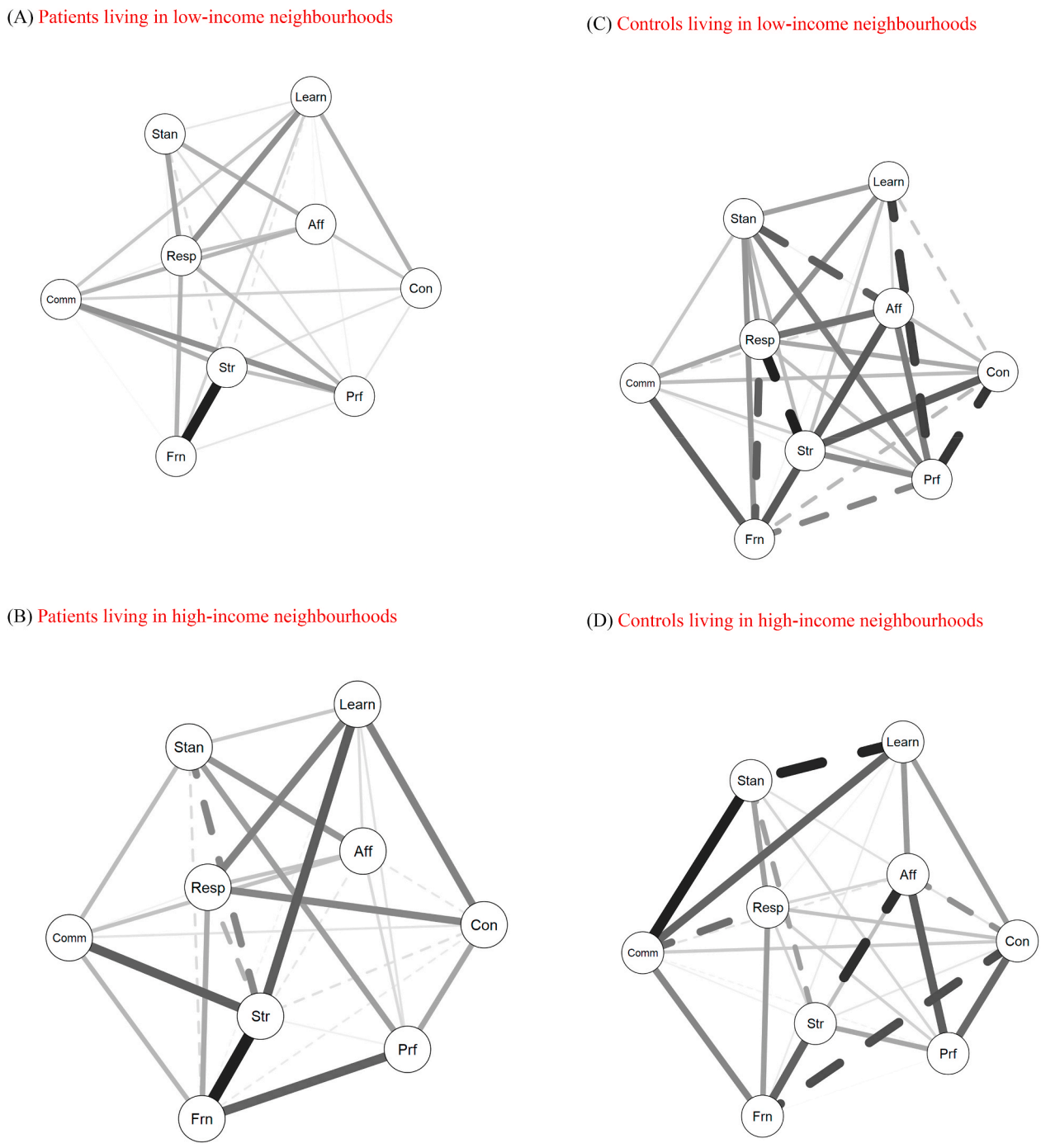

Fig. 1. Estimated networks for the study groups.
WHODAS items: *"Con"* = Concentrating difficulties; *"Str"* = Dealing with strangers; *"Aff"* = Being emotionally affected; *"Resp"* = Household responsibilities; *"Comm"* = Joining in community activities; *"Learn"* = Learning a new task; *"Frn"* = Maintaining a friendship; *"Stan"* = Standing for long periods; *"Prf"* = Work/School performance.
Broken edges represent inverse associations and *full edges* direct correlations. The *width* of the edges and the *color saturation* represent the weight of the edges.

structural characteristics (such as neighbourhood socioeconomic status) may systemically affect the health and well-being of the individuals inhabiting these environments, instituting barriers to healthy living and development (Vargas et al., 2020). A wide array of mechanisms has been proposed in order to explain those relationships. Among them, we can highlight the role of chronic stressors, such as financial strain (Silva et al., 2016), housing conditions, unsatisfactory living environment, unhealthy lifestyle, stigmatised reputation of the area (Drukker and van Os, 2003), exposure to crime, low perceived safety, loss of perceived control (Wilson et al., 2016), or worse working conditions and more pronounced job insecurity (Bauer et al., 2009), as well as poor coping resources, such as barriers to housing and services (Drukker et al., 2006; Steele et al., 2006), lack of educational opportunities (Vargas et al., 2020; Wilson et al., 2016), and low social support (Kahn et al., 2000; Krabbendam, 2005; Ku et al., 2020).

Secondly, our results could help to personalize treatments, since it could allow the identification of different potential functioning areas to be prioritized in the treatment of first episode of psychosis according to the patient's neighbourhood characteristics. Our findings suggest that in patients who live in low-income neighbourhoods, training for activities

of daily living, such as household responsibilities, could be a good target of treatment. Nevertheless, in patients who live in high-income neighbourhoods, difficulties in dealing with strangers could be high-priority area. In any case, the development of policies that aim to address the socioeconomic and health inequalities should be an important focus (Sweeney et al., 2015).

Limitations of the present study should be considered. Our data were based on a cross-sectional assessment, so we do not know the temporal relationships and which area impacts first. Secondly, although the influence of neighbourhood household income appeared after controlling for parental socioeconomic status, not everyone who lives in the same neighbourhood has the same socioeconomic level, so a certain bias cannot be ruled out. Moreover, given the stability values of our edge-weights and some centrality measures, our results should be carefully considered. On the other hand, the use of network psychometric is still a young field with many unanswered questions (Epskamp, 2017). Further studies will be needed to explore the relationships between neighbourhood socio-economic level and functioning using the dynamic network approach.

Table 2
Centrality measures for the WHO-DAS items across study groups.

WHODAS items	Patients living in low-income neighbourhoods			Patients living in high-income neighbourhoods			Controls living in low-income neighbourhoods			Controls living in high-income neighbourhoods		
	Betweenness	Closeness	Strength	Betweenness	Closeness	Strength	Betweenness	Closeness	Strength	Betweenness	Closeness	Strength
Concentrating	−0.882	−1.620	−1.354	−0.731	−0.716	−0.485	−0.714	−0.337	−0.232	−0.145	0.989	0.885
Dealing with strangers	−0.126	−0.280	1.249	2.427	2.098	2.114	0.089	−0.180	−0.121	−0.145	0.498	−0.219
Being emotionally affected	−0.504	−0.671	−1.541	−0.731	−1.456	−1.207	−0.714	0.323	0.458	0.291	−0.188	0.954
Household responsibilities	2.520	2.012	1.334	−0.468	−0.237	−0.116	0.491	1.043	1.205	−1.018	−1.633	−1.079
Joining in community activities	0.252	0.839	0.539	−0.731	−0.544	−0.788	−0.714	−1.821	−1.694	0.291	0.526	1.214
Learning a new task	−0.126	0.125	0.058	−0.205	0.420	0.291	−0.714	−0.936	−1.149	0.727	0.622	−0.551
Maintaining a friendship	−0.126	−0.242	0.174	0.322	0.636	0.871	0.893	0.813	0.265	2.037	0.733	0.011
Standing for long periods	−0.504	−0.140	−0.337	0.322	−0.019	−0.084	−0.714	−0.230	−0.142	−1.018	0.142	0.528
Work performance	−0.504	−0.024	−0.122	−0.205	−0.183	−0.597	2.098	1.325	1.411	−1.018	−1.688	−1.743

Abbreviations: WHODAS, World Health Organization Disability Assessment Schedule.

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Declaration of competing interest

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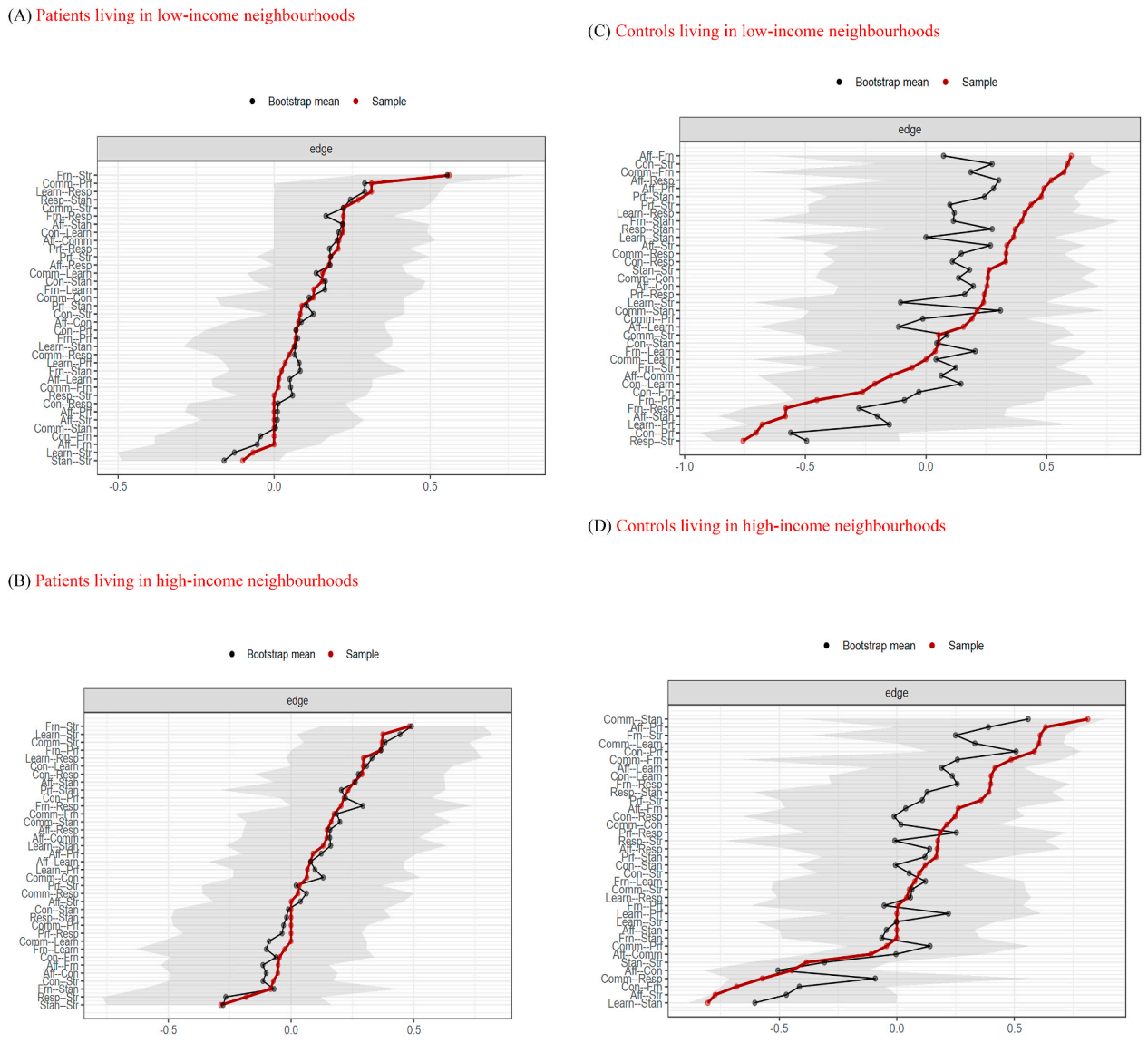

Fig. 2. Bootstrapped confidence intervals of estimated edge-weights for the estimated networks.
WHODAS items: *"Con"* = Concentrating difficulties; *"Str"* = Dealing with strangers; *"Aff"* = Being emotionally affected; *"Resp"* = Household responsibilities; *"Comm"* = Joining in community activities; *"Learn"* = Learning a new task; *"Frn"* = Maintaining a friendship; *"Stan"* = Standing for long periods; *"Prf"* = Work/School performance.

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