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A population-based cross-sectional study of cognitive deficits in paranoia

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ABSTRACT

This study sought to investigate the association between paranoia and performance in a range of neurocognitive domains using a large community sample. We conducted a cross-sectional survey of 4507 individuals within the PISMA-ep Study. We used a large community sample selected after multistage sampling using standard stratification techniques. Socio-demographic variables such as age, gender, educational level, urbanicity, and geographical region were recorded. The Spanish version of the Green Paranoid Thought Scale (S-GPTS) was used to assess paranoid thoughts. The Screening for Cognitive Impairment in Psychiatry (SCIP) was used to assess neurocognitive performance both globally and by domains (i.e., immediate and delayed verbal learning, working memory, verbal fluency and processing speed). Individuals with high S-GPTS paranoia scores showed significantly lower performance on global cognitive function and also on immediate (but not delayed) verbal learning, working memory, verbal fluency and processing speed. These results held statistical significance even after controlling for the effects of education and estimated IQ. We propose that cognitive deficits may be mediators of paranoid thinking formation and need to be considered when assessing patients with high levels of paranoia.

1. Introduction

Delusion-like experiences are relatively common among both adolescents and adults in the general population (Altman et al., 1997; Hanssen et al., 2003; Guerrero-Jimenez et al., 2018). Paranoid thinking is possibly the most frequent topic among delusional and delusion-like phenomena and subclinical paranoia seems to be a rather common trait in the general population (Freeman et al., 2005). Additionally, subclinical paranoia is associated with functionally relevant elements such as avoidant coping, less use of rational coping negative attitudes to emotional expression, and submissive behaviours (Freeman et al., 2005). In its most intense presentation, paranoid ideation may adopt the form of paranoid delusions which are also relatively frequent among the general population with prevalence ranging from 5% to 8% (Freeman et al., 2011; Polner, 2019). Paranoid delusions are also core symptoms in a variety of schizophrenia spectrum disorders and other psychotic disorders, including delusional disorder within which the paranoid subtype is the most frequent (de Portugal et al., 2013; Munoz-Negro et al., 2015).

Cognitive deficits occur in schizophrenia spectrum disorders such as delusional disorder, schizotypal personality disorder, schizotypal symptoms, as well as in full-blown schizophrenia (Rossler et al., 2015). Indeed, cognitive deficits are considered core symptoms in schizophrenia (Rossler et al., 2015), including deficits in verbal and non-verbal memory, attention, processing speed, and a broad variety of other executive functions (Heinrichs and Zakzanis, 1998; Reichenberg et al., 2009). Moreover, impairments in working memory, attention, processing speed and verbal learning have also been found in subjects with schizotypal personality disorder (Siever et al., 2002). Similarly, deficits in all components of executive function (including flexibility, impulsivity, and updating), as well as in memory processes have also been reported in patients with delusional disorder (Ibanez-Casas et al., 2013).

Among the general population cognitive deficits are also associated with psychotic experiences including deficits in verbal knowledge, working memory and visual memory (Mollon et al., 2016). Results on processing speed are conflicting as some studies find no association (Mollon et al., 2016) while others do report a correlation between

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psychotic experiences and poorer processing speed, even if these experiences were transient (Carey et al., 2019). There is also evidence that subclinical psychosis is negatively associated with executive functions, sustained attention, verbal intelligence, working memory and processing speed (Rossler et al., 2015).

Many previous studies explore a proneness to paranoia mediated by a variety of cognitive biases and metacognitive distortions (Murphy et al., 2018; Savulich et al., 2015). However, little evidence exists as to whether paranoia in non-clinical populations is associated with cognitive deficits. Yet, some studies do indicate that healthy individuals scoring high on delusional ideation show a poorer mnemonic performance, including lower recall, more memory biases (i.e., false memories), more memory errors (i.e., false-alarms in recognition) and more errors for set-shifting, planning, suggestibility and source monitoring, in comparison with individuals who score low on delusional ideation (Laws et al., 2011; Laws and Bhatt, 2005; Dehon et al., 2008; Dagnall and Parker, 2009). In addition, a recent study reported that paranoia associated with lower self-reported task orientation, lower persistence, higher distractibility and lower flexibility (Saarinen et al., 2020). However, other study suggested that measures of memory, IQ, executive functions, and mental flexibility did not correlate with measures of paranoia in healthy individuals (Woodward et al., 2007). We set out to explore whether paranoia is associated to cognitive deficits in a large and representative sample of the Spanish general population. We hypothesized that, in view of previous findings both in clinical and subclinical populations, higher scores in paranoia could be associated with poorer cognitive performance among the general population.

2. Methods

2.1. Design and sample

The PISMA-ep was a cross-sectional study whose methodology, sampling, and interviewing methods have been described elsewhere (Cervilla et al., 2016). In brief, a multistage sampling was performed using standard stratification techniques. We aimed to interview 4518 randomly selected participants living in all 8 provinces of the Andalusian region utilizing a door-knocking approach. Out of the 5496 eligible participants approached, 4507 (83.7%) agreed to take part in the study, completed the interview, and were finally included in the study.

The authors declare that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All procedures involving human participants were approved by the Research Ethics Committee of the University of Granada (Approval # C.0003663). Written informed consent was obtained from all participants.

2.1.1. Socio-demographic factors

Information on socio-demographic variables such as age, sex, educational level, urbanicity and geographical region was recorded. Each participant's premorbid IQ was calculated with a Spanish version of the Barona, Reynolds, and Chastain's formula (Barona et al., 1984; Bilbao-Bilbao and Seisdedos, 2004). This formula uses the sociodemographic variables of age, gender, academic level, urbanicity and geographic region to estimate the participant's IQ (estimated or premorbid IQ).

2.1.2. Paranoia assessment: Spanish version of green paranoid thoughts scales (S-GPTS)

The Green Paranoid Thought Scales (GPTS) is an instrument adapted to the current definition of paranoia that can be used for both clinical and healthy populations (Green et al., 2008). The GPTS is composed of a total of 32 items rated on a 5-point Likert scale ranging from 1 (Not at all) to 5 (Totally) points. Items are grouped into two 16-item scales. Scale A assesses ideas of social reference relevant to paranoia while scale B assesses persecutory thoughts. Scores on each scale range from 16 to 80 points, with higher scores reflecting a higher level of paranoia. Each scale can be administered individually, but they can also be totaled as an overall score. Dimensions of conviction, preoccupation and distress can also be calculated through specific items in scales A and B. The GPTS has been validated for the Spanish population (S-GPTS) showing very good psychometric properties (Cronbach's $\alpha = 0.89$ for the non-clinical group, and 0.86 for the clinical group) (Ibanez-Casas, I. et al., 2015). This study used Receiver Operating Characteristic (ROC) curves analyses to explore the decision validity of the instrument using both a clinical and a non-clinical sample. A cut-off score of 92 points in the S-GPTS total score gave a 97.35% specificity and 65% sensitivity to distinguish between clinical and non-clinical levels of paranoia.

2.1.3. Cognitive function assessment: screening for cognitive impairment in psychiatry (SCIP)

The SCIP was designed to detect cognitive deficits in psychotic and affective disorders (Purdon, 2005). It is a paper-and-pencil measure that requires around 15 min to complete. The SCIP includes 5 different measures: 1) Verbal Learning Test-Immediate, which measures the number of words that the subject is able to recall immediately after listening to a 10-word list; 2) Working Memory Test, measuring the number or characters correctly remembered after the participant is presented with sets of three consonants and asked to recall those with different delay intervals; 3) Verbal Fluency Test, in which the number of words beginning with a certain letter that the subject is able to generate in 30 s' time is recorded; 4) Verbal Learning Test-Delayed, which measures the number of words recalled five minutes after administering Verbal Learning Test-Immediate; and, 5) Processing Speed Test, a visuomotor tracking task in which the subject must complete as many cells as possible in 30 s using the correspondence between letters and their equivalent in Morse Code. The score in each subscale can be added up to obtain a global cognitive score. The Spanish adaptation (SCIP) showed adequate psychometric properties (Pino et al., 2008), and a more recent study found moderate reliability not only among schizophrenia and bipolar disorder patients, but also in healthy controls (Cronbach's α of 0.74, 0.79, and 0.67 respectively) (Cuesta et al., 2011). The average score on the SCIP for the cognitively non-affected group (defined as those who were above −1SD the normal mean on traditional neuropsychological instruments) was 77.68 (SD = 9.29). According to Rojo and colleagues (Rojo et al., 2010), scores below 70 on the global SCIP scale are considered signs of cognitive impairment. This optimum cut-off was selected taking into account that the SCIP is a screening tool and, hence, it is essential to maximize its sensitivity (87.9%).

2.2. Statistical analysis

We explored distributions and frequencies of all variables in the analyses. We used linear regression to test for the associations between scores on paranoia (S-GPTS) and cognitive measures estimating both, crude and adjusted associations (accounting for potential confounders such as educational level and premorbid IQ). Age and sex were also checked for as potential confounders, but were finally excluded from the reported models given the absence of any significant contribution. Effect sizes of cofactors were estimated with 90% confidence intervals for calculated r^2 values. Additionally, we re-tested these associations using a categorical outcome of high levels of paranoia using a previously validated cut-off point that classifies respondents with a total score above 92 on the S-GPTS as "high" paranoia scorers, and those below 92 as "low" scorers (Ibanez-Casas et al., 2015). These two groups were tested for comparability with regard to gender distribution, educational level, age, and estimated premorbid IQ. Chi-square tests were used to analyse gender and educational level distributions, whereas one-factor ANOVA was used to compare age and premorbid IQ. Differences in cognitive functioning between the groups were analysed using multivariate ANCOVA controlling for education and premorbid IQ for each of the

individual SCIP tasks, as well as for the overall SCIP score. Effect sizes for all the comparisons were calculated using Cohen's δ formula. All analyses were performed using SPSS v. 23.0 (IBM Corp, 2015).

3. Results

3.1. Sample characteristics and sociodemographic variables

Out of 5496 potential responders approached, 4507 participants completed the study with a resulting 83.7% response rate. A full description of the sample's sociodemographic characteristics has been reported elsewhere (Cervilla et al., 2016). A summary of socio-demographic and educational characteristics of the sample can be found on Table 1. The sample's age range was 18–75 and mean age was 42.8 years (SD = 15.22). Officially published education levels for the general population in Andalusia around the time of the interviews were lower than those of the sample: Basic education = 28.4%; Secondary education = 49.9%; University education = 21.7% (Instituto Nacional de Estadística, [INE] 2012). No significant gender or age differences were found between the high and low paranoia groups (all $p > .05$). However, the groups were not equivalent with regard to educational level and estimated IQ ($p < .05$).

3.2. Paranoia scores

The sample's mean score on the S-GPTS paranoia scale was 39.86 points (SD: 12.93). A total of 50 individuals (1.1%) scored above the cut-off of 92 points on the S-GPTS and were considered "high" paranoia scorers. The remaining 4457 participants (98.9%) were considered "low" paranoia scorers. A small but significant negative correlation was found between overall S-GPTS scores and educational level ($r = -0.091$, $n = 4507$, $p < .05$). A lower estimated IQ was also found among those with a higher score on the S-GPTS ($F = 3.168$, $p = .003$) (Table 1).

3.3. Cognitive deficits and paranoia

Using a continuous outcome consisting of overall paranoia scores on the S-GPTS, we found that higher levels of paranoia were significantly associated with poorer overall cognitive function as measured using total SCIP scores (see Table 2). Results were robust both crudely ($F = 107,25$; $p = .0001$; $r^2 = 0.023$(90% CI:.015–0.030)) and after taking into account the estimated premorbid IQ and educational level ($F = 103.77$; $p = .0001$; $r^2 = 0.023$(90% CI:.015–0.030)). Additionally, cognitive impairment (scoring less than 70 on the total SCIP) did also associate with higher paranoia scores (means: 41.8; SD:10.8 vs. 38.1. SD:10.6; $t = -9.6$; $p = .0001$; $r^2 = 0.021$, 90% CI:.019–0.022). Similarly, higher paranoia scores associated significantly with lower performance on four out of the five SCIP cognitive subtests (i.e., verbal learning test-immediate; working memory test, verbal fluency test and processing speed test). Albeit, no association was found between paranoia and verbal learning test-delayed. Associations between paranoia and these cognitive tests kept robust after adjusting for estimated premorbid IQ and educational level (Table 2).

Table 3 shows the results of the performance comparisons between high and low paranoia scorers on all five SCIP subtests and on its global cognitive score, as well as the confidence intervals and the effect sizes for these comparisons. Overall, our analyses showed lower global cognitive scores in the high paranoia group. In addition, individuals in the high paranoia group showed significantly lower scores on immediate verbal learning, working memory and on the total SCIP score and, marginally, on verbal fluency. No significant differences were found on the delayed verbal learning test or on the processing speed test (all $p > .05$), although results tended to be poorer among the high paranoia group. Likewise, Cohen's δ values revealed a trend-association for high S-GPTS scores and poorer neuropsychological outcomes on the SCIP since most effect sizes ranged from medium to high, with the working memory subtest showing the highest effect size (Cohen's δ = 0.70).

Table 1
Sample's Sociodemographic Characteristics by Paranoia Groups.

	High[a] n = 50	Low[a] n = 4457	Statistic	Significance (p)
Gender (n,%)				
Women	26 (52%)	2267(51%)	$\chi^2 = 0.026$	.493
Men	24 (48%)	2190 (49%)		
Education (n,%)				
Basic	35 (70%)	2329 (52%)	$\chi^2 = 0.005$	**.042***
Secondary	10 (20%)	13,228 (30%)		
University	5 (10%)	805 (18%)		
Age (in years) Mean (SD)	41,84 (14,29)	42,81 (15,23)	$F = 0.448$	.654
Premorbid IQ Mean (SD)	102,47 (17,84)	110,51 (18,83)	$F = 3.168$	**.003***

KEY:.
[a] High paranoia (S-GPTS>92 points) vs. Low Paranoia (92 or less on S-GPTS).

Table 2
Associations between Paranoia (S-GPTS scores) and SCIP Cognitive Tests.

	Unadjusted[a] F (p significance)	r^2 Effect (90% CI)	Adjusted[a,b] F (p significance)	r^2 Effect (90% CI)
Verbal Learning Test-Immediate (VLT-I)	71.3 (.0001)*	.016 (.010–.022)	74.4 (.0001)*	.027 (.019–.034)
Working Memory Test (WMT)	52.8 (.0001)*	.012 (.006–.022)	49.2 (.0001)*	.022 (.015–.28)
Verbal Fluency Test (VFT)	61.0 (.0001)*	.0013 (.007–.018)	49.5 (.0001)*	.022 (.015–.029)
Verbal Learning Test-Delayed (VLT-D)	1.088 (.297)	.0 (0.0–0.0)	0.77 (.38)	.0012 (0.006–0.017)
Processing Speed Test (PST)	36.7 (.0001)*	.0008 (.0004–.012)	25.8 (.0001)*	.017 (.010–.023)
Total Cognitive Score (SCIP)	107.2 (.0001)*	.023 (.015–.030)	103.8 (.0001)*	.033 (.024–.041)

*Statistically significant at the $p<.05$ level.
KEY:.
[a] S-GPTS score (Crude). Degrees of Fredom:1.
[b] Covariates = Education, Premorbid IQ. Degrees of Freedom:3.

4. Discussion

The aim of this study was to explore, in a general population sample, whether higher levels of paranoia were associated with cognitive deficits. We also aimed at establishing whether specific cognitive deficits were related to paranoia. In the event, we found that paranoia indeed associated with poorer performance at both, general cognitive measures and most specific cognitive domains tested. Our results are fairly novel and unique as previous evidence on the relationship between cognitive deficits and paranoia is scarce. This is particularly the case when exploring general population samples. Paranoia is part of many psychotic disorders and a frequent delusional theme. Hence, our findings could plausibly throw some light toward a broader understanding of cognition in these clinical presentations.

Table 3
Comparisons Between Paranoia Groups (High vs. Low) Effect Sizes for SCIP Cognitive Subtests.

	High[a] $n = 50$ Mean (SD)	95% CI	Low[a] $n = 4457$ Mean (SD)	95% CI	F	p	Cohen's δ (90% CI)
Verbal Learning Test-Immediate (VLT-I)	16,10 (4,47)	16 - 16.2	18,25 (4,87)	16.9–19.6	5,96	**.015***	.46 (0.44–0.48)
Working Memory Test (WMT)	15,18 (4,58)	15 - 15.3	18,46 (4,75)	17.1 −19.8	14.05	**<0.05***	.70 (0.68–0.71)
Verbal Fluency Test (VFT)	13,96 (5,39)	13.8 - 14.1	16,46 (6,45)	14.7 - 18.3	3,81	.051	.42 (0.40–0.43)
Verbal Learning Test-Delayed (VLT-D)	4,76 (2,16)	4.7 - 4.82	5,58 (2,24)	4.96 - 6.2	2,90	.088	.37 (0.35–0.39)
Processing Speed Test (PST)	8,90 (4,53)	8.77 - 9.03	10,37 (4,49)	9.13 - 11.6	2,18	.139	.33 (0.31–0.35)
Total Score	58.9 (15,84)	54.5 - 63.3	69.12 (16,82)	68.6 - 69.6	7,41	**.006***	0.63 (0.61–0.64)

KEY:.
*Significant at the $p < .05$ level Covariates = Education, Premorbid IQ.
[a] S-GPTS cut-off score of 92 in total score.

4.1. Paranoia and sociodemographic variables

Our groups with high and low scores on the S-GPTS were comparable with regard to age and gender distribution, but there were differences in education and premorbid IQ between the groups. Educational levels of the sample are consistently lower than those reported by the Spanish National Institute of Statistics for the Andalusian population (Instituto Nacional de Estadística, [INE], 2012). This may be a potential caveat of the study likely to limit the generalizability of some of our findings. Additionally, individuals scoring high in paranoia tended to have lower education and lower premorbid IQ, which has been found previously (Jenkins et al., 2009; Freeman et al., 2011). Nevertheless, the potential confounding effects exerted by education and premorbid IQ were accounted for by using multivariate ANCOVA analyses that showed completely parallel results using crude or adjusted models.

4.2. Paranoia scores

The sample's mean score on the paranoia S-GPTS scale was around 39 points, very much coincidental with that reported in the non-clinical sample when the scale was validated (Ibanez-Casas et al., 2015). Hence, this result is in line with what could be expected suggesting sample representativeness. We also found that 1.1% ($n = 50$) of our sample scored above the high-paranoia cut-off of 92 on the S-GPTS. This is a lower percentage than that found in previous studies. The most comprehensive study to date is that by Freeman et al. (2011) using data from 7281 participants in the Adult Psychiatric Morbidity Survey in England. However, they assessed paranoia using only three items of the Psychosis Screening Questionnaire (Bebbington and Nayani, 1995) in hierarchical succession, instead of a specific psychometric instrument assessing delusional thoughts. They found that 1.8% ($n = 125$) of their community sample endorsed all three items, which is not dissimilar to our results. Using the GPTS, Green et al. (2008) found that 3% of their non-clinical sample scored above the mean of the clinical group on the GPTS total score. However, they used a convenience sample of literate participants within two higher education institutions in London, instead of a representative sample. In summary, differences between our prevalence results and those in previous studies can be attributed to differences in sampling procedures. Additionally, differences may also derive from the different methods used to determine the presence and the degree of paranoia in these studies.

4.3. Paranoia and global cognitive impairment

We found that higher scores on paranoia strongly associated with poorer global cognitive performance. This held true even after taking into account potential confounders such as premorbid IQ or educational level. Furthermore, effect sizes for the associations were fairly high for two different paranoia outcomes tested (i.e., continuous or dichotomous). This finding is supportive of previous reports on cognitive deficits in paranoia using general population samples (Saarinen et al., 2020),or paranoid delusions (Evans et al., 2019). In addition, our data provide epidemiological support to repeated reports on cognitive deficits in psychotic disorders exhibiting paranoia (Rossler et al., 2015; Ibanez-Casas et al., 2013). Indeed, high-paranoia individuals scored significantly lower than low-paranoia participants on the SCIP total score, sowing a large effect size (0.63). On the other hand, it has been repeatedly reported that paranoia may be linked to cognitive biases (Murphy et al., 2018; Savulich et al., 2015; Freeman et al., 2008) and reasoning deficits (Garety and Freeman, 2013). We hypothesize that cognitive deficits, premorbid IQ and lower education maybe make subjects with lower cognitive capacity prone to paranoid thinking possibly via proneness to cognitive biases (Ibanez-Casas and Cervilla, 2012). Admittedly, poorer cognitive performance in paranoia could also be explained by their common associations with childhood trauma (Bentall et al., 2001) or with dopamine-mediated deficits in frontal areas (Abi-Dargham et al., 2002).

4.4. Paranoia and memory deficits

This study also found that higher levels of paranoia were associated with lower performance on the SCIP subtests measuring immediate, but not delayed, verbal learning and working memory. A poorer performance on the immediate verbal learning test would suggest difficulties with encoding new information. Yet, an absence of deficits on the delayed tasks could indicate a better capacity for memory storage and/or retrieval of information that has been previously learned (Delis et al., 1991). A closer look at our data shows that the group high in paranoia tends to "forget" fewer items from the immediate to the long-term trial in comparison with the low paranoia group. This better recall could be due to a hypervigilance trait consistently found in individuals with clinical delusions (Ibanez-Casas et al., 2013) that could also be occurring in high-paranoia scorers.

A poorer performance on immediate verbal learning indicates that the verbal components of working memory are also impaired. Working memory is a core cognitive function that has been found impaired across several schizophrenia spectrum disorders. Indeed, deficits in working memory have been found in delusional disorder, both before and after a first episode of schizophrenia, in first-degree relatives of psychotic patients, in schizotypy and in individuals with psychotic experiences in the general population (Rossi et al., 2016; Kane et al., 2016). Working memory deficits have also been consistently associated with some cognitive biases such as jumping to conclusions or need for closure biases that have been widely demonstrated in individuals with high delusional ideation, both in clinical and in healthy samples (Garety et al., 2013; Freeman et al., 2014; Ochoa et al., 2014). We propose that working memory, if not the rest of cognitive deficits reported, might be a contributor to the association between cognitive biases and poor cognitive inhibition and paranoia. Deficits in working memory would make it difficult for these individuals to manage the necessary information and, thus, to interact socially with others. This, in turn, would contribute to paranoid ideas or delusion formation, as individuals would feel a strong necessity to explain a strange experience and would take the first available explanation (Ibanez-Casas et al., 2013; Freeman et al.,

2014). Our results support the notion that an intervention to improve working memory performance could potentially prevent psychotic development in high-paranoia individuals and psychotic patients (Garety et al., 2015; Saarinen et al., 2020).

4.5. Paranoia and verbal fluency and processing speed

We found that individuals scoring high in paranoia also showed lower scores in neurocognitive functions related to verbal fluency and processing speed, but the associations attenuated after adjusting for education and premorbid IQ. This may indicate a greater influence of education and crystallized IQ on these functions, as previously reported (Mohn et al., 2014; Rapport et al., 1997).

Verbal fluency and semantic processing deficits are central to cognitive abnormalities in psychosis (Galaverna et al., 2016) with a pattern consistent with a storage deficit of semantic memory (Rossell and David, 2006). These deficits in verbal fluency seen in psychotic patients could be particularly prominent in those suffering from delusions. Indeed, patients with current delusions have shown to be more impaired in a semantic fluency task than those with no current delusions (Rossell et al., 1999). However, in non-clinical samples, it was found that individuals who are high in schizotypy do not show global semantic processing impairments as those seen in schizophrenia (Morgan et al., 2009). Our results also suggest either absence of or just minimal impairments in verbal fluency among healthy individuals despite a high level of paranoia.

Finally, processing speed is a powerful predictor of cognitive impairment as well as of fluid and general intelligence. Additionally, it has been found to be the most severely impaired cognitive function in schizophrenia (Rossler et al., 2015). However, previous findings of the association between paranoid thoughts and processing speed in healthy populations are conflicting. While some studies have found significant weak to moderate associations between subclinical psychosis and processing speed deficits (Rossler et al., 2015), other studies were unable to replicate such association (Mollon et al., 2016). The fact that this association is so robust in schizophrenia but not so much in less severe psychotic conditions suggests that clinical psychoses are associated with an increased abnormality in processing speed (Mollon et al., 2016). Overall, processing speed associated with paranoia independently of education and premorbid IQ but other potential confounders were not accounted for.

4.6. Clinical implications

From a clinical point of view, our findings indicate that cognitive assessment should be part of the diagnostic process in patients who present with paranoid ideation. We cannot suggest that our findings conform a specific pattern of cognitive impairment in paranoia, but they certainly raise the case for cognitive impairment in paranoia. In spite of scarce evidence, cognitive rehabilitation of patients with paranoid ideation can be preventative of poorer outcome and may contribute to better prognosis as suggested by previous interventions (Garety et al., 2015; Saarinen et al., 2020).

4.7. Strengths

One of the main strengths of our study is the large sample size used from the PISMA-ep study interviewing a representative sample of the population in Andalusia, Spain. Additionally, the use of specific measures of both paranoid ideation and neurocognitive functioning provided a rare opportunity to study these constructs in-depth in a community sample. We incorporated specific psychometric tests that are reliable and objective measures of both paranoia and neurocognitive functioning and we did not rely exclusively on self-reporting, which improves upon the methodology used in previous studies. Finally, the use of multivariate analyses controlling for potential confusing variables makes our results fairly reliable and robust.

4.8. Limitations

Our results should be pondered by some limitations. This is a cross-sectional study, so we cannot make assumptions about the nature of the relationship between paranoia and neurocognitive deficits, i.e., whether neurocognitive deficits lead to paranoia or vice versa. Hence, no causal association should be derived from our findings. The pattern of cognitive deficits may not be specific of paranoia as it can plausibly also be associated with other psychotic-like co-occurrent phenomena. The GPTS is not intended to be a diagnostic tool and extrapolation of findings to clinical populations is, hence, limited. In addition, it does not assess response tendency biases or social desirability.

4.9. Conclusion

Cognitive deficits have been repeatedly described across a variety of sub-clinical psychotic phenomena and schizophrenia spectrum disorders. We report an intriguing and rare, yet clear, association between higher levels of paranoia and poorer cognitive performance in a non-clinical population. Future studies are needed to establish the specificity, direction, and clinical potential of our findings.

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Authors contribution

All authors have contributed substantially to the present work. JAC, BG, & IIC designed the work and acquired data, and CMCAC contributed to the analysis and interpretation of data for this work. All authors have worked in the drafting and in the critical review of this manuscript and have approved this version. All authors agree to be accountable for all aspects of this work.

Data availability

The anonymized dataset is available from the corresponding author upon reasonable request.

Declaration of Competing Interest

The authors declare no conflict of interests

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