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Research Article

Association Between Psychiatric Symptom Severity and Reaction Time: A Prospective Naturalistic Follow-up Study

Deepa Sangolkar¹, Nandlal Prajapati², Aparna Sengupta³, Sagar Karia^{4*}, Nilesh Shah⁴, Avinash Desousa⁵

¹Department of Psychiatry, AIIMS, Nagpur, Maharashtra, India

²Pacific Medical College & Hospital, Udaipur, Rajasthan, India

³MGM Medical College, Vashi, Navi Mumbai, India

⁴Department of Psychiatry, MGM Medical College, Vashi, Navi Mumbai, India

⁵Department of Psychiatry, Lokmanya Tilak Municipal Medical College & General Hospital, Sion, Mumbai, India

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ABSTRACT

Reaction time is a simple measure of cognitive functioning which gets impacted in psychiatric disorders. While existing literature has explored the effects of psychiatric illness and psychotropic medications on cognition, the influence of illness severity on reaction time remains underexplored. This study aims to evaluate the impact of severity of psychiatric illness on reaction time. The current study was conducted in a tertiary care psychiatry outpatient setting. Convenient sampling was used to enrol 100 patients newly initiated on psychotropic medications along with their relatives as controls. Reaction time was assessed using the Human Benchmark Test at baseline, one week, and one month. The Brief Psychiatric Rating Scale (BPRS) was used to gauge the severity of the symptoms. Information was documented. SPSS was used for statistical analysis, and $p \leq 0.05$ was deemed significant. Higher psychiatric symptom severity was modestly associated with slower reaction time at baseline. Reaction time decreased over follow-up alongside reductions in symptom severity; however, given the observational naturalistic design, these temporal changes cannot be attributed solely to treatment or symptom improvement. The findings support an association between clinical symptom burden and psychomotor performance and warrant confirmation in larger, adequately powered studies using standardized sampling and longitudinal modelling.

Introduction

The American Psychiatric Association states that psychiatric disorders, as defined by the DSM 5, are syndromes that indicate dysfunction in the psychological, biological, or developmental processes underlying mental functioning and are characterised by clinically significant disturbances in an individual's cognition, emotion regulation, or behaviour. [1]

Psychiatric or mental disorders entail a wide spectrum and are classified into disorders emerging in infancy, childhood, or adolescence. Delirium, dementia, amnesia, and other cognitive disorders, substance-related disorders, schizophrenia, and other psychotic disorders, mood, anxiety, somatoform, factitious, dissociative,

sexual and gender identity, eating, sleep, impulse control, adjustment disorders, personality disorders, and other conditions are all essential parts of this all-encompassing classification. [2] A hallmark of psychiatric disorders is that it is characterised by impairment in cognitive functions. [3] Various studies have demonstrated that both psychiatric disorders and psychotropic drugs are associated with impairments of cognitive profiles of patients, which include language, learning and memory, visual learning and memory, language fluency, executive function, attention. [4, 5]

Another way to gauge cognitive performance is by reaction time. Its simplicity, precision, ease of measurement, and

*Corresponding Author: Dr. Sagar Karia

Address: Department of Psychiatry, MGM Medical College, Vashi, Navi Mumbai, India

Email ✉: karia777@yahoo.com

Tel.: +91-9594530457

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adherence to a ratio scale with a genuine zero make it stand out. It is a crucial indicator of how quickly a person can react to a particular stimulus and is defined as the time interval between the introduction of a stimulus and the start of the muscle response. The study of reaction time, which is usually measured in milliseconds, is crucial in real-world situations where a delayed response can have serious repercussions. For example, reacting slowly when operating a vehicle might have negative effects.^[6]

Recognizing its crucial role in daily activities, numerous factors, including age, gender, physical fitness, health, psychological state, alertness, fatigue, distraction, body temperature, experience, anticipation, alcohol consumption, and personality type, have been found to influence reaction time. Some studies indicate that socioeconomic status (SES) is associated with reaction time and processing speed, with lower SES linked to slower reaction times and poorer performance on cognitive tasks requiring speeded responses.^[7,8] The relationship between SES and reaction time remains relatively underexplored, with most research focusing more broadly on executive functioning and cognitive development rather than specific measures of processing speed.

Several studies have shown that psychiatric disorders are also associated with impairments in reaction time. Studies of cognitive processing in schizophrenia and depression have reported significant differences in choice reaction time, highlighting the potential relationship between psychiatric illness and cognitive performance.^[9,10] Anxiety has been associated with slower reaction times, particularly at higher levels of trait anxiety.^[11] Studies also indicate that psychotropic medications have an effect on reaction time, often leading to slowed responses due to their impact on central nervous system functioning and psychomotor speed, depending on the drug class and dosage.^[12,13]

The relationship between psychotropic medication uses and reaction-time performance has been investigated across various psychiatric populations, with different medications demonstrating variable associations with cognitive functioning. Nevertheless, evidence regarding the influence of clinical and treatment-related factors on reaction time, particularly among patients receiving multiple psychotropic agents in routine clinical practice, remains limited. The present naturalistic observational study therefore seeks to assess reaction-time performance in patients prescribed psychotropic medications, examine its association with the severity of psychiatric illness, and compare reaction times between medicated patients and individuals not receiving psychotropic treatment.

MATERIALS AND METHODS

This study was conducted in the psychiatry outpatient department of a tertiary care center after institutional ethics committee approval. A convenient sampling method

was used and data was collected from 100 patients who were newly initiated on psychotropic medicines. The control group comprised consenting adult relatives of participating patients who were not receiving psychotropic medication. Relatives were selected as a contemporaneous comparison group because they were available within the same clinical setting and were assessed under similar testing conditions. However, they were not intended to represent genetically or environmentally independent healthy controls. Demographic comparability was assessed; however, potentially relevant factors such as sleep quality, caffeine and nicotine consumption, medical comorbidities, familial vulnerability and subtle neurological abnormalities were not systematically assessed. Therefore, the control group should not be considered fully equivalent to a healthy population-based control group.

They were all adults with the ability to comprehend the test and instructions and had access to a mobile phone and internet. Those with vision problems (color blindness), difficulty in moving the hands (e.g. paralysis, coarse tremors), having severe medical or neuropsychiatric conditions (e.g. delirium), and pregnant and lactating women were excluded from the study.

Written informed consent was obtained from all participants following an explanation of the study objectives and assurance regarding the confidentiality of the information provided. Sociodemographic information was collected using a semi-structured pro forma. For participants in the patient group, additional clinical details, including presenting symptoms, psychiatric diagnosis, and prescribed treatment, were documented. Reaction time was assessed using the "Human Benchmark Test" application, which presents sequential red and green colour screens. Participants were instructed to respond by touching the screen immediately when the red screen changed to green.^[14] The task was administered over five trials, and the mean response time across these trials was calculated as the participant's reaction-time score. Participants were given 5 minutes to get acquainted with the test, and then data was recorded for their performance. Reaction time was assessed immediately prior to the initiation of psychotropic drug (baseline), one week after initiation (± 2 days) and one month after initiation (± 5 to 7 days). Data for the control group were collected at corresponding time intervals. The app was installed in the android devices of authors and patients could use whatever hand they were comfortable with. Because the same reaction-time task was repeated at baseline, one week and one month, a potential practice effect was considered. The control group underwent testing at corresponding time points, allowing assessment of longitudinal changes that could partly reflect repeated exposure to the task. Nevertheless, a residual practice effect cannot be completely excluded.

The Brief Psychiatric Rating Scale (BPRS) was also administered to participants for assessing the severity of psychiatric illness. The Brief Psychiatric Rating Scale (BPRS) is an 18-item clinician-administered tool designed to measure psychiatric symptoms, particularly psychosis, in patients with schizophrenia or other mental health disorders.^[15]

BPRS scale was administered by semi structured interview conducted by trained clinician, interview lasting for 15 to 20 minutes. Each item was scored on 7 points Likert scale ranging from 1 (not present) to 7 (extremely severe), yielding a total score range of 18 to 126.

The obtained data was entered in Microsoft Excel and analyzed using the computerised software and a $p \leq 0.05$ was considered statistically significant.

As the study was observational and the sample had already been recruited, no a priori sample-size calculation was performed. This is acknowledged as a methodological limitation, and the findings are therefore interpreted as exploratory associations rather than definitive causal effects.

RESULTS

Table 1 describes the demographic profile of the study population and both the study groups are comparable on demographic parameters.

Table 1: Demographic profile of study Population

Parameters		Case (n=100)	Control (n=100)	p-value
Age (Mean $\pm$ SD)		37.20 $\pm$ 11.201	37.89 $\pm$ 13.871	0.699
Gender	Male	57	39	0.11
	Female	43	61	
Education (in yrs.)		9.58 $\pm$ 4.854	10.45 $\pm$ 5.347	0.230
Religion	Hindu	67	55	0.082
	Non-Hindu	33	45	
Marital Status	Married	75	69	0.345
	Single	25	31	
Type of family	Joint	9	12	0.489
	Nuclear	91	88	
Occupation	Employed	57	48	0.325
	Housewife	25	26	
	Unemployed	18	26	
Socio economic status	Upper middle	5	12	0.342
	Middle	23	22	
	Lower middle	58	55	
	Lower	14	11	

Among psychiatric disorders, the majority of patients were diagnosed with major depressive disorder (MDD) and related conditions, including adjustment disorder with depressed mood and somatic symptom disorder, accounting for 45% of cases. This was followed by anxiety disorders (23%), schizophrenia and related disorders (17%), and substance use disorders (15%) [Table 2].

Table 3 shows that the mean reaction time of patients gradually reduced from 395ms to 368ms in 1 month after starting medications. Furthermore, a significant difference of approximately 37ms was found in the mean reaction time scores of patients and relatives at baseline which gradually reduced on treatment with psychotropic to 16ms at 1 week and 13ms at the end of 1 month. Thereby showing that patients and relatives had comparable reaction times by the end of 1 month of treatment.

At baseline, BPRS score showed a statistically significant but modest positive correlation with reaction time ($r = 0.225$, $p = 0.024$; 95% CI: 0.030–0.404), indicating that higher symptom severity was associated with slower reaction time. No statistically significant correlation was observed at one week ($r = 0.103$, $p = 0.325$) or one month ($r = 0.038$, $p = 0.720$). Furthermore, it was observed that symptom severity and number of psychotropic medications were not significantly associated with changes in reaction time [Table 4].

Table 2: Diagnostic Distribution of Study Population

Diagnosis	Number of patients (n=100)	Percentage
Depression	45	45%
MDD	20	20%
MDD with anxious distress	9	9%
Adjustment disorder with depressed mood	9	9%
Somatic symptom disorder	7	7%
Anxiety disorder/ Anxiety related conditions	23	23%
Generalised anxiety disorder	11	11%
Panic disorder	9	9%
Premature ejaculation	3	3%
Schizophrenia and related disorders	17	17%
Schizophrenia	10	10%
Brief psychotic episode	3	3%
Schizophreniform	2	2%
Postpartum psychosis	1	1%
Schizoaffective disorder	1	1%
Substance use disorder	15	15%
Alcohol use	12	12%
Alcohol & tobacco use	3	3%



Table 3: Comparison of Reaction Times in cases and control groups over 1 month (Repeated Measures Analysis was applied)

Reaction time	Case	Control	p-value
Baseline	395.30 ± 88.785 (n = 100)	358.80 ± 53.138 (n=100)	0.001*
1 week	377.03 ± 66.822 (n = 94)	361.19 ± 55.674 (n=100)	0.071
1 month	368.19 ± 66.411 (n = 91)	355.38 ± 57.200 (n=100)	0.154

Table 4: Severity of Illness and Number of Drugs vs Reaction Time of Participants

Reaction time	BPRS score	No. of drugs
Baseline (n=100)	r = 0.225 p = 0.024*	r = 0.148 p = 0.144
1 week (n=94)	r = 0.103 p = 0.325	r = 0.048 p = 0.648
1 month (n=91)	r = 0.038 p = 0.72	r = 0.103 p = 0.33

[6 patients had lost to follow up at 1 week and additional 3 at end of 1 month, reasons being few could not visit for follow up due to some familial emergency, some had to travel out of town, some were not contactable]

The mean reaction times of patients differed significantly in different diagnostic groups at baseline, after 1 week, and after 1 month. Table 5 indicates that the highest reaction time was observed in the substance use disorder group followed by schizophrenia, anxiety and MDD, respectively. Also, the mean reaction time across diagnostic group of patients was seen to improve at each successive point of testing after initiating psychotropic medications. The differences in the reaction time scores in different diagnostic groups at the beginning of treatment and after 1 week were statistically significant.

Among the 91 patients who had both baseline and 1-month assessments, mean BPRS scores decreased significantly from 37.74 ± 7.96 at baseline to 27.30 ± 6.40 at 1 month (mean reduction: 10.44 ± 5.64 ; paired $t = 17.66$, $p < 0.001$). Mean reaction time also decreased significantly from 399.26 ± 90.54 ms to 368.19 ± 66.41 ms (mean reduction: 31.08 ± 51.07 ms; paired $t = 5.80$, $p < 0.001$).

However, the magnitude of reduction in BPRS score was not significantly correlated with the magnitude of reduction in reaction time (Pearson $r = 0.089$, 95% CI -0.120 to 0.289 , $p = 0.404$). A Spearman correlation analysis similarly showed no significant association ($\rho = 0.165$, $p = 0.118$).

DISCUSSION

In the current study, majority of patients were diagnosed with MDD, followed by anxiety disorders, while fewer participants had schizophrenia and substance use disorders. Most patients belonged to the mild severity category on the Brief Psychiatric Rating Scale (BPRS), which may be attributed to the inclusion of only those individuals who were able to understand and perform the reaction time task.

A statistically significant difference in symptom severity was observed across diagnostic groups at baseline and after one week of treatment. Patients with schizophrenia and other psychotic disorders demonstrated the highest severity scores, followed by depressive disorders, whereas anxiety and substance use disorders showed comparatively lower severity. With the initiation of treatment, a gradual reduction in symptom severity was observed across all diagnostic groups.

In our study, a statistically significant positive correlation was observed between severity of illness and reaction time at baseline. This indicates that patients with more severe symptoms exhibited slower reaction times. However, at one week and one month of treatment, as symptom severity reduced, this association was no longer statistically significant. This suggests that cognitive impairment, as reflected by reaction time, is more prominent during the acute phase of psychiatric illness and improves with reduction in symptom severity. Similar findings have been reported by Trivedi (2006), who observed that cognitive dysfunction increases with greater severity of psychiatric symptoms across disorders including schizophrenia, mood disorders, and obsessive-compulsive disorder.[16] The findings of the present study further support that cognitive deficit in psychiatric disorders may improve with appropriate treatment.

It was also observed that the number of psychotropic medications was not significantly associated with reaction time, suggesting that the use of multiple medications, when prescribed appropriately, may not adversely affect

Table 5: Psychiatric Illness vs Reaction Time

Diagnosis	Baseline (n=100)	1 week (n=94)	1 month (n=91)
MDD	369.02 ± 55.43	355.49 ± 44.23	353.41 ± 47.04
Anxiety disorders	375.22 ± 56.97	378.57 ± 62.93	358.90 ± 53.32
Schizophrenia & related disorders	434.35 ± 121.24	389.71 ± 65.13	383.18 ± 70.06
Substance use disorders	460.67 ± 121.97	419.40 ± 100.43	402.00 ± 103.19
p value	0.001*	0.001*	0.067

cognitive performance. However, further studies are required to evaluate the effects of specific drug classes and dosages. The present study suggests that the reaction time of patients at baseline was significantly higher than that of the control group. After the initiation of treatment, reaction time improved consistently and became comparable to that of controls as early as 1 week, with further improvement noted at one month. This implies that cognitive impairment associated with psychiatric illness begins to improve shortly after initiation of treatment and continues to improve over time.

Among the diagnostic groups, highest reaction time was observed in patients with substance use disorders, predominantly alcohol use disorder, followed by schizophrenia, anxiety disorders, and depressive disorders. However, by one month of treatment, reaction time scores across all diagnostic groups became comparable to each other as well as to controls. This indicates that cognitive improvement occurs across different psychiatric conditions with treatment, irrespective of diagnosis.

These findings are consistent with previous studies. Fillmore and Blackburn (2002) reported that individuals consuming impairing doses of alcohol exhibit slowed reaction times.^[17] Similarly, Maylor (1992) demonstrated that alcohol produces a general slowing of reaction time. Maylor and Rabbitt (1987) have also discussed how alcohol reduces processing speed and increases variability in performance during reaction time tasks.^[18,19] In addition, studies on schizophrenia have consistently demonstrated significant slowing of reaction time and cognitive processing,^[20,21] while Schwartz et al. (1989) reported that such slowing is particularly associated with psychotic features.^[22]

LIMITATIONS

Several limitations should be considered when interpreting the findings. First, this was a naturalistic observational study using convenience sampling, which may have introduced selection bias and limits the generalizability of the findings. No a priori sample-size calculation was performed, and the relatively small and heterogeneous diagnostic subgroups limit statistical power for subgroup comparisons.

Second, the control group consisted of patients' relatives rather than independently recruited healthy controls. Although demographic characteristics were compared, potentially important factors such as sleep quality, fatigue, caffeine and nicotine use, medical comorbidities, familial vulnerability and subtle neurological characteristics were not systematically assessed.

Third, reaction time was assessed using a repeated version of the same Human Benchmark task. Although a familiarization period was provided and controls were assessed at corresponding time points, a practice effect cannot be completely excluded.

Fourth, medication exposure was not analysed at the level of individual drugs, dose, duration or sedative burden. Therefore, the absence of an association between the number of psychotropic medications and reaction time should not be interpreted as evidence that medications have no effect on psychomotor performance.

Fifth, substance use may have influenced reaction-time performance, particularly because the substance-use disorder group had the slowest reaction times. Detailed information regarding time since last substance use, acute intoxication, withdrawal status and cumulative exposure was not systematically incorporated into the analysis.

Finally, the study duration was limited to one month, preventing assessment of longer-term changes in reaction time and medication effects. These limitations mean that the observed temporal changes and associations should not be interpreted as evidence of a causal treatment effect.

CONCLUSION

The present prospective naturalistic study found a modest positive association between psychiatric symptom severity and reaction time at baseline. Reaction time also changed over the one-month follow-up period, alongside changes in clinical symptoms. However, because of the observational design, convenience sampling, heterogeneous diagnostic groups, potential medication and substance-related effects, possible practice effects and other unmeasured confounders, these temporal changes should not be interpreted as demonstrating a causal treatment effect. The findings suggest that reaction time may be a simple measure associated with clinical symptom burden in psychiatric disorders. Larger, adequately powered prospective studies using consecutive sampling, standardized reaction-time assessment, detailed medication and substance-use characterization, and appropriate longitudinal statistical modelling are required to clarify this relationship.

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