

Lateralization Pattern in Patients with Schizophrenia and Depression

Dr. Braj Bhushan^{*}, Mr. Anand Prakash[†] and Dr. Rajneesh Gupta[#]

^{*}Indian Institute of Technology, Kanpur (UP), India

[†]University of Gondar, Ethiopia

[#]Manobal Hospital, Amritsar, India

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ABSTRACT: The objective of this study was to see the incidence of peripheral laterality in schizophrenics and depressed patients. A total of 147 male subjects (29 schizophrenics, 38 depressed, 80 non-patient controls) were asked to indicate their preferences for hand, foot, eye, and ear on the Sidedness Bias Schedule. The correlations among the laterality quotients (LQ) in all the three groups were positive and highly significant except the foot-eye correlation in the non-patient controls. The left and mixed-handed schizophrenics and depressed subjects exhibited extreme left and mixed preference for foot, eye, and ear, respectively. Hand and ear preferences emerged as the predictors of schizophrenia and depression in the logistic regression analysis. The findings indicate a possible relationship between psychopathology and extreme left-mixed dominance.

KEY WORDS: Peripheral laterality; Schizophrenia; Depression

INTRODUCTION

Since **Flor-Henry**¹ advocated the relationship between lateralization and psychopathology and **Hicks and Barton**² reported left handedness in 28% of the people with serious mental disorders lateralization has been studied in relation to different types of psychosis^{3,4}. Studies have also indicated association between depressive symptoms and schizophrenia^{5,6,7}. Such research gained impetus after propositions of the GBG model (Geschwind-Behan-Galaburda model)⁸⁻¹¹. This model suggests a causal association between prenatal testosterone levels and an array of psycho-biological phenomena.

The relationship between peripheral indices of laterality, especially handedness and schizophrenia^{12,13} as well as depression and lateralized cognitive functions^{14,15} has been a subject of interest for last couple of decade. Interestingly enough neither of the two

pathologies have yielded a conclusive association with lateralization. Initial studies indicated an increased proportion of left and mixed handedness among schizophrenic patients¹⁶, but recent research attests its link with mixed handedness^{17,18} and not left-handedness. **Chapman and Chapman**¹⁹ reported common observation of mixed handedness in individuals measuring high on psychosis-proneness and schizotypy, a finding that was further supported by **Kim et al**²⁰ and **Richardson**²¹. Although majority of the studies have attested an elevated incidence of non-right/ left handedness in schizophrenia^{22,23}. Few researchers have also reported elevated right handedness^{24,25} in the schizophrenic patients. A couple of studies have reported no association²⁶ between them. Studies examining left-handedness in schizophrenics have not yet yielded conclusive findings²⁷.

(Corresponding Author: Dr. Braj Bhushan PhD, Department of Humanities & Social Sciences, Indian Institute of Technology, Kanpur-208016, India, Email: brajbhushan1@yahoo.com)

Similarly the observations pertaining to hand lateralization and depression also seem to be divided. Several researchers have confirmed the prevalence of left-handedness in those scoring high on measures of depression^{28,29,30} whereas some have reported just the opposite^{3, 31}; however, few studies did not find any association between the two³².

Handedness, footedness, eyedness and eardness are the peripheral indicators of hemispheric lateralization. However, eyedness has been questioned as a direct indicator of cerebral dominance^{4,33} because of crisscrossing of optic fibers; footedness seems a better indicator³⁴, though both are least susceptible to environmental influences¹³.

Though much emphasis has been given to handedness, few studies have investigated footedness³⁴ and eyedness^{4,33,35,36} too. **Schiffman et al.**¹³ have reported left or mixed footedness in schizophrenia. Like handedness, studies investigating eyedness as one of the indicators of laterality in schizophrenia have reported contrasting results. **Schiffman et al.**¹³ found left or mixed eye dominance in schizophrenics whereas pure left eye dominance has been reported by others³⁶. A few have even reported mixed eye dominance^{4,33} as well as null association³⁵.

In the case of depression, compared to the other indices of laterality, eardness seems to have consensus. Most of the studies have used either dichotic listening or visual hemifield tests. Although few arguments have been raised questioning the inferences drawn from studies using dichotic listening tests and visual half-field techniques, researchers in the area of laterality agree to its usage because preference (for eye and ear) correlates quite well with hemispheric differences. **Bruder** and associates^{29, 37} have reported left ear (right hemisphere) advantage on non-verbal dichotic listening task. Few more studies³⁸ have reported similar findings. However, depressed patients show a right ear (left hemisphere) advantage on dichotic fused word or syllable tests²⁹. These findings lack universal acceptance^{37,39}. Adults with non-anxious major depression exhibited right ear (left hemisphere) preference for dichotic fused words whereas those with comorbid anxiety exhibited left ear (right hemisphere) advantage on dichotic complex tones. To the best of our knowledge studies describing footedness and eyedness in depression and eardness in schizophrenia are very few⁴⁰.

Cultural evolution across the world has favoured right-handedness⁴¹. However, while complying with social sanctions forcing or anticipating right preference in Oriental societies (such as India), the influence of left and mixed handedness might not replicate the observations made on Western samples. Either because of the social sanctions, genetic pool, or developmental vulnerabilities, the hand preference pattern, especially left-handedness, in Indians is different as compared to the western population. However, very few studies have been conducted on the Indian sample^{18,25,40} to investigate the lateralization pattern of those suffering from certain types of psychopathology. In the absence of sufficient studies it becomes essential to verify the nature of this pattern and its correlates.

Studies carried out on otherwise normal Indian sample have attempted to explore lateral preferences^{42,43}, hand preference and approval among major religious groups and hand clasping among endogamous groups⁴⁴. The prevalence of left-handedness has always been low in India. **Singh et al.**⁴³ have reported it as low as 3.2 percent. They observed a significant sex difference between handedness and relative hand skill with females exhibiting higher right hand preferences. This has been corroborated by other researchers^{42,44}. These studies have reported greater likelihood of left-handedness in men than the women. The prevalence of left handedness in later studies shows a small increase in the percentage of left-handers. For example, **Mandal et al.**⁴⁵ has reported 6.78% left-handers.

Accepting the relationship between schizophrenia, depression and anomalous dominance the present study attempted to re-examine the contradictory findings on all the peripheral indices of laterality. Our primary aim was to find out the incidence of peripheral laterality in patients with schizophrenia and depression and to validate laterality as a predictor of both disorders. It was hypothesized that schizophrenics and depressed would show higher incidence of non-right handedness as compared to the non-patient controls.

METHODOLOGY

Subjects: A total of 147 male subjects (29 schizophrenics, 38 depressed, 80 non-patient controls) participated in the study. The patients selected for this study were undergoing treatment at the Institute of Mental Health, Amritsar, India. None of them were hospitalized at the time of data collection. Proper consent of the patients/ attendants and the consulting psychiatrist were

obtained before conducting the study. The patient's group did not manifest acute symptoms and were communicative. The patients were selected for the study on the basis of their medical records and further diagnoses were done by the consulting psychiatrists adhering to the DSM-IV-TR diagnostic criteria for Schizophrenia and depressive disorder. Only those patients were included in the study whose symptom severity was rated within mild to moderate range by the treating psychiatrist. The schizophrenic patients were chronic exhibiting first-rank symptoms (thought disorder, inappropriate affect, delusions). The non-patient controls were from the adjoining cities. Unlike the patient group subjects in the NC group were selected from a pool of 342 subjects, 6.23% of which were left handed. They were drawn from the students and staff of various hospitals and universities. Because of this it was possible to strike some balance in terms of the number of subjects in the three categories. The NC group (N 80) had 21.25% left-handers, 23.75% mixed-handers, and 55% right-handers. They had disclosed the absence of any history of psychiatric treatment or hospitalization in their disclosure form. However, this group was not screened for DSM IV-TR criteria.

The mean age and education of NC group were 23.36 (SD 2.28) and 12.26 (SD 3.74), respectively. The mean age and education of schizophrenic ($M_{\text{age}} = 23.14$, SD 2.12; $M_{\text{education}} = 10.31$, SD 4.23) and depressed ($M_{\text{age}} = 23.52$, SD 3.26; $M_{\text{education}} = 11.42$, SD 1.26) groups were also akin. The groups did not differ in terms of age and education. All the subjects belonged to middle socioeconomic class and conversed in Punjabi. They were also proficient in Hindi. Both the languages are read from left to right.

Measures: The Sidedness Bias Schedule⁴⁵ was administered and subjects were asked to indicate their preference for unimanual activities on a 5-point scale (1= never, 5 = always). The subjects had to indicate their preference for left as well as the right hand on the 37-item questionnaire (Hand: writing, eating, throwing a ball, lifting a bucket full of water, using a spoon to stir, keying the lock, winding the lock, using scissors, painting, threading the needles, combing, brooming, screwing a nut, hammering a nail, opening the tap, switching the light, lighting a matchstick, tooth brushing, sorting cards, using knife, using racket for games, unscrewing the jar; Foot: kicking a ball, foot extended to climb a bus, foot on which body weight rested in standing posture, foot extended to ride a

bicycle/vehicle, foot extended in long jump; Eye: seeing through a telescope, snapping photograph by camera, gun shooting, seeing through a key-hole, preferred eye to wink; Ear: hearing telephone when both hands are free, hearing a pocket-radio, matching musical tune, sensing tick movement in wrist watch, hearing a low voice).

Several authors have developed questionnaires to measure hand preference⁴⁶⁻⁴⁹. Concurrent researchers use either of them. However, as hand preference and performance have often turned uncorrelated for a variety of perceptuo-motor tasks^{50, 51} and cultural constraints play key role in determining hand preference, we opted to use Sidedness Bias Schedule developed by **Mandal et al.**⁴⁵. This schedule (test-retest reliability $r = 0.88$) has been widely used in India^{52,53,54}. On the basis of laterality quotient ($LQ = \text{right- left/right} + \text{left}$) subjects were classified as right-handers (+. 50 to +1.00) and left-handers (-.50 to -1.00) considering it a continuous variable. Intermediate scorers were classified as mixed-handers. The schedule also indicates bias (LQ) for foot, ear and eye.

RESULTS

The mean of LQs for hand, foot, eye, and ear preferences of the schizophrenic, depressed, and NC groups are given in **table 1**.

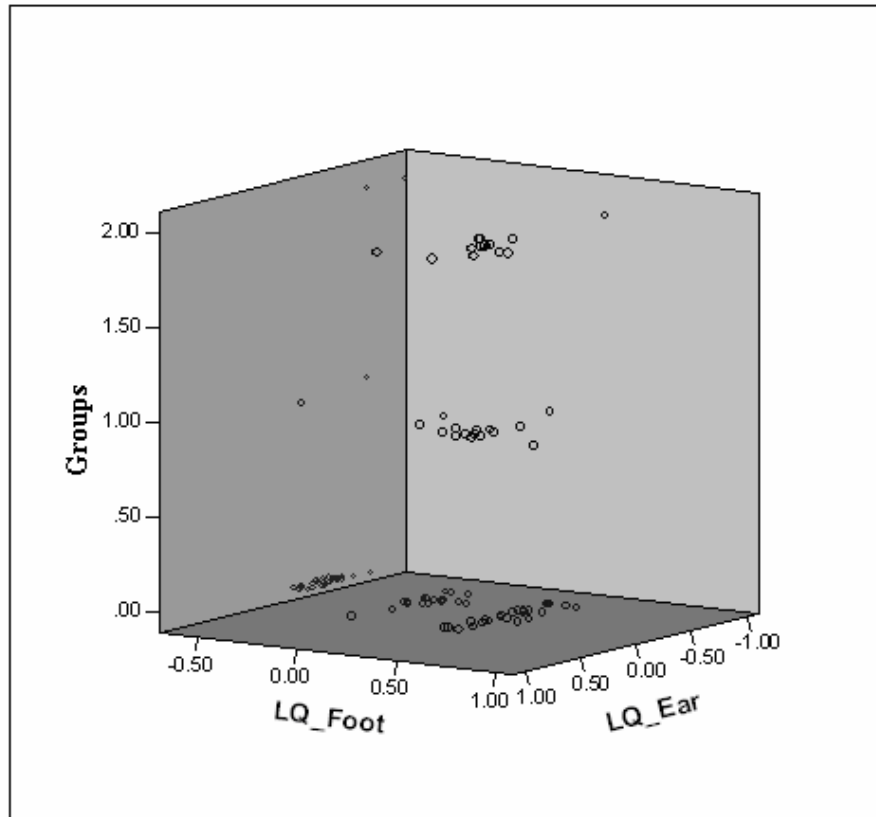
An interesting observation emerged out when cross tabulation was performed to see foot, eye, and ear dominance with respect to handedness. All the left-handed schizophrenics and depressed subjects had left-preference for foot, eye, and ear as well. Similar trend was seen in the mixed-handed schizophrenics and depressed subjects. All of them demonstrated mixed-foot, eye, and ear preferences. Further, all the right-handed schizophrenics showed right-eye preference but the foot (23.07% mixed, 76.98% right) and ear preferences (46.15% mixed, 53.85% right) were always non-left in nature. The right-handed depressed had mixed (5.71%) as well as right (94.29%) footedness. However, their eye and ear preferences were skewed in distribution. 2.86% of them had left, 20% mixed, and 77.14% had right eyedness. Similarly, 5.71% had left, 22.86% mixed, and 71.43% had right earedness. Unlike the patient groups, the foot, eye, and ear scores of the right-handed normal controls were distributed. The footedness scores of the mixed-handers were also spread across the three categories (left, mixed, and right). However, they exhibited mixed-eye and ear preferences only. All the left-hander had left-

footedness and mixed-eyedness. 94.12% of them had mixed and 5.88% right-eyedness. This indicated a possible relationship between

psychopathology and extreme left-mixed dominance. **Figure 1** illustrates the spread of LQ scores of all the four indices and symptoms.

Table 1: The distribution of left, mixed and right preferences in the three groups of subjects

LQ	Groups	N	% distribution of subjects			Mean	SD	Correlation (LQ)			
			Left	Mixed	Right			Hand	Foot	Eye	Ear
Hand	Schizophrenic	29	6.89	3.45	89.66	.75	.45	-	.92**	.71**	.72**
	Depressed	38	5.26	2.64	92.1	.77	.37	-	.83**	.95**	.80**
	NC	80	21.25	23.75	55	.26	.44	-	.69**	.27*	.49**
Foot	Schizophrenic	29	6.89	24.14	68.97	.42	.36		-	.70**	.67**
	Depressed	38	5.26	7.89	86.85	.53	.28		-	.81**	.78**
	NC	80	28.75	32.5	38.75	.06	.47		-	.13	.36**
Eye	Schizophrenic	29	6.89	3.45	89.66	.46	.38			-	.38*
	Depressed	38	10.53	18.42	71.05	.42	.47			-	.84**
	NC	80	2.5	87.5	10	.12	.27			-	.37**
Ear	Schizophrenic	29	6.89	44.83	48.28	.37	.33				-
	Depressed	38	10.53	23.68	65.79	.44	.42				-
	NC	80	0	93.75	6.25	.03	.25				-



Groups: 0 = Normal Controls, 1 = Depressed, 2 = Schizophrenics

Figure 1: Scatterplot showing the relationship between footedness, earedness and symptoms

Further, Pearson correlations were computed. The correlations between the LQs for hand, foot, ear, and eye are shown in **Table 2** and **3**. The correlations among all the variables were positive and highly significant when total LQ

scores were taken into account. Similar observations were obtained when correlation was computed separately for the three groups except the foot-eye correlation ($r = .13$) in the NC group which did not turn significant.

Table 2: Intercorrelation matrix for LQs

	LQ hand	LQ Foot	LQ Eye	LQ Ear
LQ hand	-	.80**	.63**	.71**
LQ Foot		-	.49**	.60**
LQ Eye			-	.58**
LQ Ear				-

** $p < .01$

Table 3: Regression analysis with LQ scores as predictors of symptoms

Variables	B	Wald	df	Exp (B)	Significance
Psychotic group – Normal Controls					
LQ hand	-2.083	3.624	1	.124	.05
LQ foot	-.628	.802	1	.534	NS
LQ eye	-.607	.749	1	.545	NS
LQ ear	-1.695	4.964	1	.184	.05
Schizophrenic – Depressed groups					
LQ hand	-2.749	1.798	1	.064	NS
LQ foot	6.918	4.910	1	1010.539	.05
LQ eye	-2.189	1.799	1	.112	NS
LQ ear	.034	.001	1	1.035	NS

As the outcomes were categorical logistic regression was carried out to assess the nature of relationship between LQ, schizophrenia, and depression. At the first step attempt was made to differentiate between normal controls and the patient groups (0 = patient groups, 1 = NC). The obtained -2LL (143.228) and the goodness of fit (Hosmer & Lemeshow $\chi^2 = 175.391$, $df = 8$, $p < .001$) were indicative of a better fit. The observed R square suggests that laterality quotient can predict schizophrenia and depression to certain extent (Cox and Snell R square = .332, Nagelkerke R square = .444). The laterality quotient of hand and ear emerged as significant predictors of pathology (see table 3) with B values indicating that schizophrenia and depressive disorder increases with decrease in LQ for handedness and eardness. It is imperative that decrease in LQ will result to increase in non-right hand and ear preferences. Therefore it can be interpreted that left and mixed hand and ear preferences are significant predictors of schizophrenia and depression, thus accepting the hypothesis.

Thereafter logistic regression was performed to see if LQ of the four indices can establish distinction between schizophrenics and depressed (0 = schizophrenics, 1 = depressed). There was a significant difference between foot preference of schizophrenics and depressed subjects (see table 3); -2LL value was 81.985 with smaller Cox and Snell R^2 (.135) and Nagelkerke R^2 (.181) values. Further, Hosmer and Lemeshow χ^2 (11.567) did not turn significant

DISCUSSION

The present findings do not support high incidence of left handedness in schizophrenic and depressed subjects in comparison to the non-patient controls. The higher incidence of right handedness in schizophrenics lends support to the findings of **Taylor et al.**²⁴ and **Tiwari**²⁵. The present findings of depressed subjects are in consonance with few earlier studies^{3,31}. It merits mention here that the previous studies on Indian samples have come forward with contrasting findings. While **Tiwari**²⁵ has reported right-hand dominance in schizophrenics, **Upadhyay et al.**¹⁸

reports mixed-handedness in them. Present study supports the findings of **Tiwari**²⁵.

The left and mixed-handed schizophrenics and depressed subjects exhibited extreme left and mixed preference for foot, eye, and ear, respectively. This finding is of substantive importance. According to **Kang and Harris**⁵⁵ inconsistent left-handers show cross lateral preference for foot, whereas consistent left-handers show uncrossed preference. These observations were made on normal subjects. The present findings show an extreme side-bias in left and mixed-handed schizophrenics and depressed subjects indicating a possible relationship between schizophrenia, depression, and cerebral lateralization.

Studies of western societies have yielded 9:1 (right:left) demographic ratio⁵⁶ with majority reporting a continuous J-shaped distribution⁵⁷. However, the handedness distribution in male right-handers reported by **Tan**⁵⁸ was not J-shaped. Further, **McManus**⁵⁶ has also advocated that the number of left-handers have increased from the last century. This distribution is visible in the schizophrenic and depressed groups reported in this study but the NC group seems to violate it. It merits mention that the NC group was selected from a pool of subjects where 6.23% were left-handers. Although the distribution of hand preference is not exactly J-shaped in the Indian society the selection of mixed and right-handers for the present study has lead to the higher incidence rate of left and mixed peripheral lateralities in the NC group. It merits mention that social and parental pressure in the Indian society demands switching hand preference in those who are innately left-handed. However, we did not collect information about the history of hand change in the subjects.

The correlations between the LQs for hand, foot, ear, and eye are similar to those reported earlier^{51,52}. The nonsignificant correlation between hand and eye in the normal controls stands in isolation. Though **Cannon et al.**^{4,33} has questioned eyedness as a direct indicator of laterality several studies have reported modest correlation between hand and eye. It merits mention that **Hebbal and Mysorekar**⁵⁹ failed to find any interrelationship between them.

It is also interesting to note that footedness, eyedness, and earedness are least susceptible to cultural influences. As crisscrossing of optic fibers blur the possibility of eyedness as an indicator of lateralization, the other two relatively influence-free measures (from cultural sanctions) have emerged as the predictors of

schizophrenia and depression. Neurological investigations have endorsed certain abnormalities in the brains of persons with schizophrenia are restricted to or are worse usually in the left hemisphere. For example, schizophrenia subjects show thinning of the left parahippocampal gyrus and fusiform gyrus⁶⁰, left temporal horn enlargement⁶¹, reduction in size of the left medial temporal lobe⁶², and loss of synaptic proteins from the left thalamus⁶³. It merits mention that few investigators have come forth with neurobiological evidence signifying association between schizophrenia and reduced corticocortical⁶⁴/fronto-temporal connectivity⁶⁵. As the present study did not investigate the role of any such variable, it is not possible for us to lend support to the neurobiological observations simply on the basis of behavioural variables.

The present study has certain limitations also. It had only male sample. Hand preferences were not looked to separate out skilled and unskilled activities. Further studies on diverse and larger samples are needed beside the study of female population to avoid sample-specific characteristics obtained in the present study

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