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CONGRUENT AND NON-CONGRUENT PATTERN OF POSTURAL PREFERENCES AND PREFERRED HAND IN AN ADOLESCENT POPULATION

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ABSTRACT

The establishment of motor system in humans track the basic principle of contralateral control of distal movements. At the anatomical level this concept is demonstrated in nearly complete crossing of corticospinal fibres which innervate distal muscles, including hand muscles. However, a particular quality of the human brain is that the two hemispheres are not symmetrical but are distinguished in a number of tasks, including the motor control of the two hands. Classical human right handedness is believed a behavioural manifestation of that specialization. We investigated the relationship between handedness, Congruent and Non-congruent pattern of arm folding and digital interlocking.

KEY WORDS: ***Handedness, Arm folding, Digital interlocking, Cerebral dominance***

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INTRODUCTION

Laterality is defined as the structure and function of the paired organs or of two uniformly organized areas of non-paired organs, distributed on the left and right sides[1]. Definite functions are represented in a different manner in the two sides of the brain. Laterality is not only structural but also functional. Structurally, the cerebral cortex is demarcated anatomically into two hemispheres, the left and the right cerebral hemisphere. Roughly the two cerebral hemispheres are consistent in appearance, though not in structure and functions. For example, the left cerebral hemisphere is found to have comparatively more gray matter, larger planum temporale, longer sylvian fissure, and wider occipital lobe. On the other hand, the right hemisphere is reported to be heavier, having massive Heschl's gyrus and an extensive frontal lobe[2]. This structural asymmetry turns out to functional asymmetry. For the larger part of manual activities nine out of every 10 human being prefer to use their right hand rather than the left hand[3]. The contribution of the two hemispheres regarding motor control is not symmetrical which is strongly supported by clinical evidence. Considerable motor deficits are caused due to damage to the left hemisphere than to the right hemisphere. Damage to left hemisphere can diminish not only the motor function of the ipsilateral left hand but also the contralateral right hand[4]. Injuries leading to apraxia which is a disorder of complex movement such as dressing or tool use , necessitate typically left frontal and parietal lobes and the white matter underlying[5]. The existence of ipsilateral activation was pointed out by majority of researchers. However there is no accordance as to whether these activations are correlated exclusively with primary motor cortex or with higher order cortices and whether they are feature of the non-dominant hand or both hands[6]. Handedness has a positive correlation with footedness, ear preference and eye preference[7]. Another research from patients with aphasia still lie in wait for replication among the countless indigenous and influential surveillance of the famous Russian neuropsychologist Alexander Romanowitch Luria[8], He was knocked by the robust inclination for side with which we fold our arms i.e arm folding (AF) and clasp fingers i.e hand clasping (HC) yielding another index of lateral preference. Controversial results were given by early studies instantly testing the relationship between handedness, AF and HC. Some studies reported no definite relationship between handedness and AF or HC[9]. Few researchers reported a positive relationship between right handedness and right thumb top preferences[10] but no such relationship for AF[11].

MATERIALS AND METHODS

A sample of 210 student volunteers were selected from various schools for the study. They were selected in such a way that the sample for our study consisted of equal number of right handed and left handed volunteers. Sample selection was based on Systematic random sampling method.

Inclusion criteria

1. Consenting individuals both male and female between 11- 17 years.
2. Consenting right handers matching to left handers were rolled in.

Exclusion criteria

1. Individuals having any gross deformity were excluded
2. Individuals who cannot give consent to participate in the study.

The parents of these volunteers were informed about the intended study, its procedures and consent was also obtained from the parents of each volunteer before inclusion in this protocol, which received the approval of the Institutional Human Ethics Committee.Handedness was assessed by Edinburgh Handedness Inventory[12].Eventually participants were asked for their postural preferences Arm folding and digital interlocking.

Arm folding

Participants were requested to fold their arms. Preference was assessed by the arm in the uppermost position.

Digital interlocking

Participants were requested to clasp their hands with the fingers interlaced. Preference was assessed by the thumb on the top position.For statistical analysis, participants were divided into four groups according to their uppermost thumb and arm position[13]:

1. RR (right arm top / right thumb top)
2. LL (left arm top / left thumb top)
3. RL (right arm top / left thumb top)
4. LR (left arm top / right thumb top)

Groups 1 and 2 will subsequently be referred to as exhibiting a 'Congruent pattern', and groups 3 and 4 as exhibiting a 'Non-congruent pattern'.

STATISTICAL ANALYSIS

The statistical analysis and interpretations were performed by the statistical package namely IBM statistics-20. The P-Values less than or equal to 0.05 ($P \leq 0.05$) were considered as statistically significant.

RESULTS & DISCUSSION

Table 1
Frequency and percentage distribution of Handedness and Arm folding (Congruent / Non-congruent pattern)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LL	65	31.0	31.0	31.0
	LR	40	19.0	19.0	50.0
	RL	41	19.5	19.5	69.5
	RR	64	30.5	30.5	100.0
	Totall	210	100.0	100.0	

Table-1 shows a higher percentage for the congruent pattern LL-31% & RR-30.5% and low percentage for Non-congruent pattern LR-19% & RL -19.5 %

Table 2
Arm folding relationship between left and right handers

Handedness	H & AF				Total
	LL	LR	RL	RR	
L	65	40	0	0	105
R	0	0	41	64	105
Total	***65***	***40***	***41***	***64***	***210***

Table -2 shows Left handers had a high preference for Congruent pattern LL (65) and Non-congruent pattern LR (40) whereas, right handers had a high preference for Congruent pattern RR (64) and Non-congruent pattern (41).

Table 3
Chi-square Tests for Arm folding (Congruent / Non-congruent pattern)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	210.000[a]	3	.000
Likelihood Ratio	291.122	3	.000
N of Valid Cases	210		

Table-3 shows a Asymptotic 2 sided significance in crosstabulation.

Table 4
Frequency and percentage distribution of Handedness and Digital interlocking (Congruent / Non-congruent pattern)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LL	81	38.6	38.6	38.6
	LR	24	11.4	11.4	50.0
	RL	27	12.9	12.9	62.9
	RR	78	37.1	37.1	100.0
	Total	210	100.0	100.0	

Table - 4 shows a higher percentage for the congruent pattern LL-38.6% & RR-37.1% and low percentage for Non-congruent pattern LR-11.4% & RL -12.9%

Table 5
Digital interlocking relationship between left and right handers

Handedness	H & DI				Total
	LL	LR	RL	RR	
L	81	24	0	0	105
R	0	0	27	78	105
Total	81	24	27	78	210

Table -5 shows Left handers had a high preference for Congruent pattern LL (81) and Non-congruent pattern LR(24) whereas, right handers had a high preference for Congruent pattern RR (78) and Non-congruent pattern (27).

Table 6
Chi-square Tests for Digital interlocking (Congruent / Non-congruent pattern)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	210.000[a]	3	.000
Likelihood Ratio	291.122	3	.000
N of Valid Cases	210		

Table-6 shows a Asymptotic 2 sided significance in crosstabulation.

Table 7
Frequency and percentage distribution of Handedness and Arm folding & Digital interlocking (Congruent / Non-congruent pattern)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	LL	60	28.6	28.6	28.6
	LR	46	21.9	21.9	50.5
	RL	48	22.9	22.9	73.3
	RR	56	26.7	26.7	100.0
	Total	210	100.0	100.0	

Table - 7 shows a higher percentage for the congruent pattern LL-28.6% & RR-26.7% and low percentage for Non-congruent pattern LR-21.9% & RL -22.9%

Table 8
Arm folding & digital interlocking relationship between left and right handers

Handednessl	AF & DI				Total
	LL	LR	RL	RR	
L	52	13	29	11	105
R	8	33	19	45	105
Total	60	46	48	56	210

Table -8 shows Left handers had a high preference for Congruent pattern LL (52) and Non-congruent pattern RL (29) whereas, right handers had a high preference for Congruent pattern RR (45) and Non-congruent pattern LR (33).

Table 9
Chi-square Tests for Arm folding & digital interlocking (Congruent / Non-congruent pattern)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	63.689[a]	3	.000
Likelihood Ratio	69.295	3	.000
N of Valid Cases	210		

Table-9 shows a Asymptotic 2 sided significance in crosstabulation.

Few authors opine, at the level of primary motor cortex ipsilateral activations are present in hemispheric asymmetries[14]. Some researchers profess that during movements of left or right hand there is similar quantity of activation in the ipsilateral motor cortex and handedness is attributed to an achievable hemispheric asymmetry of higher order motor cortices[15]. In the primary sensorimotor cortex still some others do not find any ipsilateral activation[16]. Asymmetries in activation generated by movements of dominant and non-dominant hand are present only during complex movements is also not made perfectly clear[17]. As suggested by few papers, more general feature is also present during simple movements[13]. While determining the preferred posture in arm folding and digital interlocking in 55 patients with aphasia who were right handed due to injuries to left hemispheric, Luria launched that patients with familial left-handedness, left-top position in digital interlocking, or a left-top position in arm folding, or a had a similarly healthy prognosis to recover from aphasia as that of ambidextrous and left handed patients[8]. As it seems to be little environmental bias to impact, side preference for arm folding and digital interlocking is exceptionally fixed. Researchers also have investigated tested whether non-congruent lateral preferences, i.e the combination of arm folding and digital interlocking might be a more delicate marker for attenuated specialization of cerebral hemisphere where left top positions were preferred by all participants for arm folding and digital interlocking [18]. As a sequel of this left limb bias, participants who exhibited a left arm top predisposition were also more likely to exhibit a left thumb top predisposition which means, postural patterns involving arms and hands they showed a congruent pattern .Given the adequate evidence both experimentally and clinically that the left hemisphere is more crucial in controlling motor functions than the right cerebral hemisphere in right handers[19]. Of this well ordered motor predominance of the left hemisphere the higher generality of left top postural preferences seems to be a sequel. On the other hand, divergence from this authorized pattern should implicit decreased motor dominance of left hemisphere. In actual fact findings show that for conventional handedness items in digital interlocking a right-top position was associated with a more frequent non right hand preference, and for those participants who also put the left arm on top in arm folding, this divergence was especially evident. Accordingly, related to right-hand preferences congruent (LL, RR) posture combinations were more persistent, and with non-right-hand preferences non-congruent (RL, LR) posture combinations were more persistent, but this contrast remained most conspicuous for the congruent group LL and the non- congruent group LR. Arm folding and digital interlocking are bilateral limb postures, which need bimanual coordination and hence the participation of the corpus callosum [20]. Weakened functional asymmetries of cerebral hemisphere have been associated to callosal morphology[21]. Compared to right handers a massive anterior half of the corpus callosum was seen in non right handers[22]. It might be described by a different participation of the corpus callosum in arm folding and digital interlocking. For distal and proximal postures of limb interhemispheric cross talk differs with distal movements of forearm, wrist, and hand, more pertinent to digital interlocking, being primarily controlled by the contralateral hemisphere, and proximal movements of the arms, more pertinent to arm folding, being under additional bi-hemispheric control[23]. For common hand actions the more contralaterally innervated distal limb posture digital interlocking drifted from the common left top position, in the case of an absence of a clear right hand preference. For hands interestingly, commissural fibres connecting homotopic motor areas are almost absent[24]. The reason for a stronger susceptibility of distal muscles to cortical lesions than proximal ones is also these unilateral versus bilateral innervations of distal and proximal muscles[25]. Another study examined the correlation between handedness, arm folding, hand clasping and foot overlapping in left and right-handers, which showed high significance as these correlations are indicative of the effects of cerebral dominance [26]. As compared to arm folding in actual fact, some few reports would recommend that postural preferences appear more firm for digital interlocking[27]. The distinctive extent of bilateral control over arm folding and digital interlocking, respectively, might also describe why positive schizotypal features were found to be associated with the non-congruent postural combination RL, in which the arm folding position drifted from the customory left-top position[13] .

CONCLUSION

About 90% of people are right handed and only 10% are left handed. Handedness is related to functional lateralization for cerebral dominance, and may also be related to different category of psychopathology. Thus, it could be that weakened specialisation which had lead to an early inception of the more atypical right-top position in digital interlocking, while the one for arm folding would be little affected by a weakened specialisation of the cerebral hemisphere due to its more bilateral innervations.

CONFLICT OF INTEREST

Conflict of interest declared none.

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