# Correlation of Handedness with High Cerebral Function

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## Abstract:

***Background:*** Handedness in human kind means a lot apart from social impact. It gives a hint to localization of dominant hemisphere. This study was done on Kirkuk University students & well concluded that activities other than only hand writing are well correlated to high cerebral function like learning & memory, speech & language. Family history is important in this aspect.

***Objective:*** To explore correlation of handedness to candidate performance & other daily activities which need high cerebral function. It's relation to family history is well addressed. The patterns of speech fluency were studied.

***Subjects and methods:*** Subjects included in this cross sectional study were selected randomly from students in different colleges in Kirkuk University from Jan. 2012 – Jan. 2013. Proposing sheets of information & asking candidates directly by researchers about wanted data & the result were fixed in appropriate boxes and then analyzed properly.

***Results:*** Among 242 students 148 (61.15%) were using right hand during writing while 94 (38.85%) using left hand during writing. Some of them were in forced by their parents to change handedness during early childhood. Handedness were different during other activates, correlated well with performance & got family history.

***Conclusion:*** Handedness correlated with many parameters other than hand writing. Important daily activities, performance at college, ability in mathematics, drawing, quality of hand writing were all observed.

***Key words:*** Handedness, Students, High cerebral function, Kirkuk.

## Introduction:

Handedness depends on cerebral dominance. The concept of cerebral dominance replaced by complimentary specialization one for sequential-analytic processes (categorical) hemisphere & concerned mainly with language, the other for visuospatial relations (Representational hemisphere) [(1)]. Handedness appears to be genetically determined [(2)]. Learning is acquisition of information and memory is retention & storage of this. Memory is divided into explicit and implicit forms. It is further subdivided into episodic memory for events and semantic memory for facts (words, rules and languages) [(3)]. Priming which is facilitation of recognition by prior exposure to subject, then non associative learning which is about single stimulus and lastly associatitive learning correlates with relation of one stimulus to another. These involve short term memory, amenable for disruption by trauma and drugs while long term memory stores information for years or life& resists to disruption [(4)]. Working memory is a form of short term memory that keeps information available while one bases on it [(5)]. Use of MRI and PET provided insight or at least glimpses into ways serial processing of cognition, language, mathematics, drawing, and

writing occur in the brain [5]. Language is one of fundamental bases of human intelligence and key part of human culture. The primary brain areas concerned with language are arrayed along & near the Sylvian fissure of categorical hemisphere. Wernickes area in the posterior end of superior temporal gyrus concerned with comprehension of information which projects via Arcuate fasciculus to Broca's area in frontal lobe immediately in front of the inferior end of the motor cortex. Broca's area processes the information received from Wernickes area into a detailed and coordinated pattern for vocalization then project pattern via a speech in articulation area in insular to motor cortex which initiate the appropriate movement of lips, tongue larynx to produce speech. The Angular gyrus, behind Wernickes area, appears to process information from words read in such away than can be converted into the auditory forms of words in Wernickes area [5]. It is interesting that in individuals who learn second language in adult hood, MRI reveals that the portion of Brocu's area concern with it is adjacent to but separate from the area concerned with native language, however in children who learn two languages early in life only single area is involved with both. It is a well-known that children acquire fluency in a second language more easily than adult. Fluency is related to categorical hemisphere while stammering or stuttering has been found to be associated with representational hemisphere & widespread over activity in cerebral cortex & cerebellum, which includes increased activity of supplementary motor area [6]. Brain regions involved in arithmetic calculation has highlighted two areas: in the inferior portion of the categorical frontal lobe concerned with number facts and exact calculation and mathematical ability. Men have larger brain than women and are said to have superior spatial skills and ability to navigate. Parietooccipital area process sequential information for drawing and hand writing [7]. The aim of this study was to assess frequency of handedness & its correlation to high cerebral function among students in Kirkuk University & to compare the available data with what was published from other universities& localities.

## Subjects and methods:

This cross sectional study was done in university of Kirkuk during Jan. 2012-Jan. 2013 & (250) students were enrolled from different colleges & different classes of both sexes. Special sheets were prepared by researchers including information about whether the student using right Hand or the left hand during writing and during five activities, eating, cleansing, using microscope, when kicking or throwing a ball and using a racket. The other information concerned with forcing children to change handedness. The next data concerned with five very valid functions of one's brain, performance (top rank, middle or low) during previous years, and ability for memorization, mathematics, drawing & quality of hand writing. Family history was the next point searched for and included sister &brothers asked for their handedness. The last point in the sheet included speech &language assessed as fluency. Eight papers were dropped from the study owe to uncoordinated, non-conclusive data. Tables & statistical work performed by university staff in community medicine and Chi square

method employed for concluding *P* values if appropriate. Consent for performing the study was taken from Deans.

## Results:

From (250) students responded to questionnaire, the data used was only (242) sheets as others were not conclusive. There were 148 (61.1%) students using Right hand during writing and 94 (38.8%) Left handed. Inquiring for enforcement by either parent to change handedness during early childhood revealed that 15 (34.9%) Right handed and 28 (65.1%) of Lt. handed were subjected to such attitude, this is shown in (table 1). During other activities like eating, right hand was used by 137 (92.5%) of right hander's while left hand used in 11 (7.4%) of them. Most of left hander's 75 (79.7%) also use Left hand during eating while 19 (20.2%) students use right hand. Handedness during other activities like cleansing, using microscope, when kicking or throwing a ball and using racket in both right and left handers is demonstrated in (table 2). Comparing performance as being in top, middle or low rank during previous years showed that 44 (47.3%) Rt. Handed students ranked top superseded by 49 (52.7%) left handers who were top in their performance while 13 (48.1%) left handers were low, not so different from 14 (51.9%) of right handers whose performance not so satisfactory. This is shown in (table 3). Memorization and recall were very good in 92 (62%) of right handers while so in 70 (74.5%) of left handers. Those with unsatisfactory memory were 9 (9.6%) left handed and 8 (5.4%) right handers. While 96 (64.9%) of right handers showed very good mathematics ability in distinction with 60(63.8%) of Left handed students. Drawing ability was not good in 49 (33.1%) of right handers but only 18 (19.1%) left handed students were bad drawers. Hand writing quality was poor in 3 (3.2%) Left handed candidates while very good in74 (50%) right handed students. This is well grouped in (table 4). Influence of family history was more to left handers as 59 (62.8%) students admitted to have either a brother or sister who is left handed while 56 (37.8%) of right handers have another member in their family who is also Left handed (table 5). The last information demonstrates language effect, 10 (71.4%) left handed students were very fluent while this was seen in 4 (28.6%) right handers; the others speak not so fluent. This is shown in (table 6).

**Table (1):** Frequency distribution of study sample regarding forcing children by parents to change handedness during early childhood.

| Forced children | Rt. handed (%) | Lt. handed (%) | Total |
|---|---|---|---|
| Yes | 15 (34.9%) | 28 (65.1%) | 43 (100%) |
| No | 133 (61.2%) | 66 (38.8%) | 199 (100%) |
| Total | 148 (61.2%) | 94 (38.8%) | 242 (100%) |

$X^2$=15.2 d.f =1 P< 0.05

**Table (2):** Frequency distribution of study sample by handedness during certain cognitive activities.

| Type of activity | Rt. handed | | Lt. handed | | Total | |
|---|---|---|---|---|---|---|
| | using Rt. hand | using Lt. hand | using Rt. hand | using Lt. hand | using Rt. hand | using Lt. hand |
| During eating | 11 (7.4%) | 137 (92.5%) | 75 (79.7%) | 19 (20.3%) | 86 (35.5%) | 156 (64.4%) |
| During cleansing | 20 (13.5%) | 128 (86.5%) | 79 (84%) | 15 (16.0%) | 99 (40.9%) | 143 (59.1%) |
| Using microscope | 17 (11.5%) | 131 (88.5%) | 73 (77.7%) | 21 (22.3%) | 90 (37.2%) | 152 (62.8%) |
| Kicking or throwing a ball | 29 (19.6%) | 119 (80.4%) | 70 (74.5%) | 24 (25.5%) | 99 (40.9%) | 143 (59%) |
| Using racket | 16 (0.8%) | 132 (99.2%) | 66 (70.2%) | 28 (29.8%) | 82 (33.9%) | 160 (66.1%) |

**Table (3):** Frequency distribution of study sample by academic performance during their previous years.

| Level of performance | Rt. handed | Lt. handed | Total |
|---|---|---|---|
| Top Rank | 44 (47.3%) | 49 (52.7%) | 93 (100%) |
| Middle Rank | 90 (73.8%) | 32 (26.2%) | 122 (100%) |
| Low Rank | 14 (51.9%) | 13 (48.1%) | 27 (100 %) |
| Total | 148 | 94 | 242 |

$X^2$= 16.7 d.f = 3 P<0.05

**Table (4):** Frequency distribution of the study sample by their ability & performance for cognitive activities.

| Type of ability | Rt. Handed | | | Lt. handed | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Very good | Fair | Not good | Very good | Fair | Not good | Very good | fair | Not good |
| Memorization | 92 (62.2%) | 48 (32.4%) | 8 (5.4%) | 70 (74.5%) | 15 (15.9%) | 9 (9.6%) | 162 (66.9%) | 63 (26.0%) | 17 (7.1%) |
| Mathematics | 96 (64.9% ) | 43 (29.1%) | 9 (6.0%) | 60 (63.8%) | 26 (27.7%) | 8 (8.5%) | 156 (64.5%) | 69 (28.5%) | 17 (7.0%) |
| Drawing | 56 (37.8 %) | 43 (29.1%) | 49 (33.1%) | 55 (58.5%) | 21 (22.3%) | 18 (19.1%) | 111 (45.9%) | 64 (26.4%) | 67 (27.7%) |
| Hand writing | 74 (50%) | 52 (35.1%) | 22 (14.9%) | 65 (69.1%) | 26 (27.7%) | 3 (3.2%) | 139 (57.5%) | 78 (32.2%) | 25 (10.3%) |

**Table (5):** Frequency distribution of study sample by the significance of family history as regards Handedness.

| Type of handedness | Yes | No | Total |
|---|---|---|---|
| Right handed | 56 (37.8%) | 92 (62.2% | 148 (100%) |
| Left handed | 59 (62.8%) | 35 (37.2%) | 94 (100%) |
| Total | 115 (47.5%) | 127 (52.4%) | 242 |

$X^2$=14.2 d.f =1 P<0.05

## Discussion:

Handedness depends on cerebral complementary specialization. Handedness means more than laterality as is associated with other high cerebral functions .It not only hand writing but related to other tasks performance with hand preference [8]. To our knowledge this is the first study conducted in Iraq. In this study 148 (61.1%) candidate out of (242) were right handed, while 94 (38.3%) where left handed, in comparison to Korean college student studying 866 candidates, (22%) of them were left handed it was very clear that their sample was too extensive compared to our sample [9]. In our study no one admitted to be bi manual unlike a study done in USA showing (10%) of population who are actually bimanual [10]. In this study performance of other activities rather than hand writing where different between right and left hander but in a study done in United kingdom, it was shown that degree of handedness and not only direction (consistence versus inconsistence) was more powerful tool than traditional way based only on direction ( right versus left) [11] . Inconsistant handedness was associated with intrahemispheric interaction leading to increase in memory retrieval, believe updating and cognitive flexibility [12]. In a study done in Edinburgh measurement of hand performance was divided to three sub groups in right handers.

- ✓ Inventory exclusive strong (Rs) right-handers (they always used right hand for more than 8 out of 10 daily activities.
- ✓ Exclusive week (Rw) right handers used >3 out of 10.
- ✓ Predominant (Rp), who preferred right hand for most item but used left hand for at least one activity

[13]. In this study (131) right hand (88.5%) of Rt. hander &17 (11.5%) of left handers were using right eye for microscope. Similar to a study showing that sighting dominance is a behavioral preference for one eye over the other during mono ocular viewing condition [14]. During kicking and throwing a ball 191 (80.4%) of right handed students were using right foot, while 29 (19.6%) right handed cross preference was related to what was seen in Korean college study [15], which was conducting to obtain normative data on foot preference in relation to hand preference. Footedness fact as for skilled unipedal actions and for balance, stabilization and varied in direction , strength , so well related to handedness in mixed footers and left handers [15] . In this study 132 (89.2%) of right handers used right hand for using racket, 16 (10.8%) used Lt. Hand. In present study level of performance well correlated with handedness so 44 (47.3%) where in top rank, 49 (52.7%) of left handed were in the top, while in another study consistency of handedness regardless of direction predicts base line memory, accuracy and potential for memory enhancement [16] . There is an observation in other study than consistent handed individuals are more authoritarian [17]. Two studies using MRI to demonstrate relations of working memory well documented that hemispheric lateralization of verbal and spatial memory is well organized during adolescence [18, 19]. In this study the same applies to memorization and mathematics ability, for both students who were right handed using were very good in 92 (62.2%) & 96 (64.9%) respectively while drawing & hand

writing quality were better in left handed & seen in 55 (58.5%) and 65 (69.1%) respectively. This observation was consistent with a study relating handedness indices and success published in Netherlands [19]. The relationship between handedness and drawing was well validated in a study from Greece [20, 21, 22]. In our work family history in form of presence of Lt. handed brother or sister was seen in 56 (37.8%) while more frequently encountered in left handed 59 (62.8%) this was strengthened by a study. The last important observation in our work is the fact that left handed students are more fluent than right handers as 10 (71.4%) left hander can speek fluently while (23) (28.6%) of right Handers can do so, this is in accordance with a studies from United kingdom showing motor laterality as an indicator to language & speech development [23,24,25].

## Conclusion:

Handedness is not just an observational variability in human kinds, beside hand writing, it is well correlated to other types of activities during person s life. It has localization importance. Right handed students are more frequent than Left handed students. In regards hemispheric specialization, handedness was well correlated with level of performance. Ours study demonstrated that memorization, mathematics, drawing and hand writing quality are so different in different handed groups .The importance of family history in left handed students is well shown . Language and speech which are the most sophisticated and characterizing features in human kind species also dependant on handedness and documented in our study.

## Recommendations:

1. Inform the students, teachers, observers that left handedness can be associated with good characters like hand writing quality and drawing.
2. Doctor awareness is to correlate handedness with pathological states & diseases like schizophrenia, dementia, personality disorders, stroke etc.

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