

RESEARCH ARTICLE

Ocular dominance and its association with handedness among medical undergraduates: A cross-sectional study

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ABSTRACT

Background: Despite the symmetry of the body, there is an inherent preference for the parts of one side of the body over the other. It is apparent in the hands. In addition to hand preference, there is also preference for the visual input of one eye over the other. The preferred eye is known as dominant eye or ocular dominance. **Aim and Objective:** This study aims to determine the association between handedness and ocular dominance among medical undergraduates. **Materials and Methods:** A cross-sectional study included one hundred 2nd year medical undergraduates of 19–21 years of age. Informed consent from the participants and Institutional Ethical Clearance were obtained. Hand preference was determined using Edinburg Handedness Inventory. Ocular dominance was tested by Miles test. Data obtained were statistically analyzed. **Results:** About 82% of subjects were right handed and 18% left handed. By Miles test, 76% were right eye dominant and 24% were left eye dominant. On cross-tabulation, 19.5% right handed were left eye dominant and 55.6% left handed were right eye dominant. About 74% showed uncrossed hand ocular dominance and 26% showed crossed dominance (Chi-square value = 5.03, df = 1, $P = 0.03$). **Conclusion:** Study showed significant association between dominant hand and dominant eye wherein 26% of subjects showed crossed dominance. Evaluating eye hand dominance or crossed dominance might be helpful to assess learning difficulties and also helpful to young players or athletes that allow them to choose whether to hit with their left or right hand or to swap hits. This is a crucial topic for laterality research in the future.

KEY WORDS: Handedness; Ocular Dominance; Miles Test


INTRODUCTION

Functional lateralization occurs in the paired organs of the body, such as hands, legs, and cerebral hemispheres.^[1] Handedness is defined as the preferred hand for executing a motor activity or the most skilled hand at doing a task. Ocular dominance, also

known as eye dominance or eyedness, is the tendency to prefer visual information from one eye over the other.^[2]

The majority of people are right handed and prefer to use their right hand for both skilled and unskilled tasks. Most people are also right handed, preferring to use their right eye for sighted activities or monocular activities such as gazing through a microscope or through a telescope. However, approximately 10% of the population prefers to use their left hand, and about 30% prefer to use their left eye. This indicates that at least 20% of the people will prefer to utilize one hand and the other eye.^[3]

Many theorists, especially in the field of education, have concentrated on brain functional asymmetry, also known as

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cerebral laterality, which is identified by hand preference. It is known fact that the educational system has strongly encouraged all children to write with the right hand. Although attempts are made to change handedness, no effort is made to alter the sighting eye.^[3-7]

People are not aware of whether they are using their right or left eye in the same way as they are aware of whether they are using their left or right hand. Dominance wise eyes function as one's hand. They capture the image with one eye and transmit it on to the other, where they begin to evaluate the object by polishing it with their fingertips or balancing objects with two hands. The preferred eye does not always correspond to the preferred hand and when they are different, the condition is referred as cross-dominance.^[8] Delcato contended that consistent handedness and eyedness (as well as footedness) are required for appropriate intellectual development, notably in reading and speech, in their study.^[5]

The importance of laterality in the development of academic learning shows a strong relationship between cross-dominance and learning difficulties, as well as with literacy issues.^[9] Hence, the present study thus aimed to determine the association between handedness and ocular dominance in medical undergraduates.

MATERIALS AND METHODS

A cross-sectional study included one hundred 2nd year medical undergraduates of 19–21 years of age. Phase II professional year medical students who gave their consent were enrolled for the study. Ethical clearance for the conduct of study was obtained by Institutional Ethical Clearance. Self-structured questionnaire which consisted of study participants college ID, gender, and other sociodemographic variables was collected. Handedness and ocular dominance were determined.

Hand preference was determined using Edinburg Handedness Inventory (EHI). Subjects with handedness scores <0 were considered as left handed, subjects with scores >0 were considered as right handed.^[10,11] $(RH-LH/LH+RH)$ was the formula to assess the hand preference after the participants filled the questionnaire. Participants were asked to mark their preferences in the use of hand in following 10 activities; writing, drawing, throwing, use of scissors, tooth brush, knife, spoon, broom (upper hand), striking match, and opening box (lid).

Ocular dominance was tested by Miles test. The subject was asked to extend both arms and to bring both hands together in front of the face to create a small opening. Then with both eyes open, they were asked to look through the opening at a distant object. Then, he/she was instructed to see the object alternately closing the eyes or slowly to draw the opening

back to the head to determine which eye is viewing the object, that is, the dominant eye.^[12]

Data Analysis

The data obtained were statistically analyzed using SPSS version 16. Descriptive statistics, mean, percentage, and standard deviation, were applied and inferential statistics like Chi-square test were used to assess the association between handedness and ocular dominance. $P < 0.05$ was considered statistically significant.

RESULTS

The total number of subjects included in the study was 100. The mean age was 18 ± 2 years. About 82% of subjects were right handed and 18% were left handed [Figure 1] as assessed by EHI. By Miles test, 76% were right eye dominant and 24% were left eye dominant [Figure 2]. On cross-tabulation [Table 1], 19.5% right handed were left eye dominant and 55.6% left handed were right eye dominant. About 74% showed uncrossed hand ocular dominance and 26% showed crossed dominance (Chi-square value = 5.03, $df = 1$, $P = 0.03$).

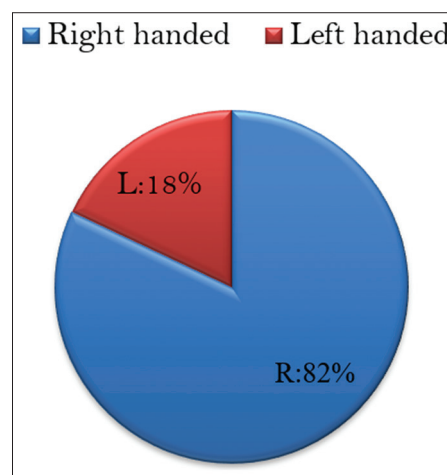


Figure 1: Distribution of study subjects according to handedness

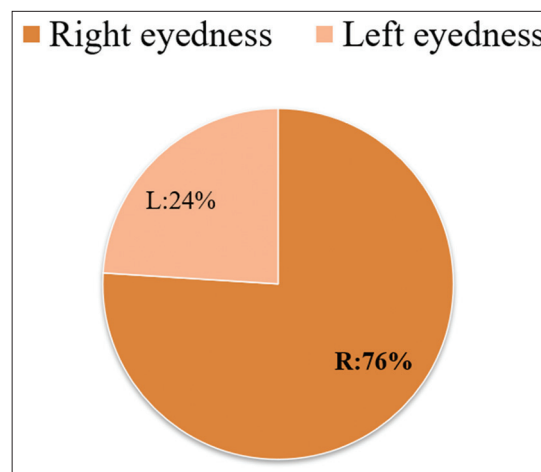


Figure 2: Distribution of study subjects according to eyedness

Table 1: Cross-tabulation of eyedness and handedness

Miles test	Handedness		Total
	Right hand	Left hand	
Right eye	66 (80.5%)	10 (55.6%)	76 (76.0%)
Left eye	16 (19.5%)	8 (44.4%)	24 (24.0%)
Total	82 (100.0%)	18 (100.0%)	100 (100.0%)

Chi-square value=5.03, df=1, P=0.03

DISCUSSION

The present study showed that 82% of study population were right handed and 18% were left handed as assessed by EHI. About 76% of subjects were right eye dominant and 24% were left eye dominant. There were 19.5% of subjects who were right handed with the left eye dominance and 55.6% of left-handed subjects with the right eye dominance. About 74% showed uncrossed hand ocular dominance and 26% showed crossed dominance. Our study also discovered a substantial link between dominant hand and dominant eye, with 26% of respondents showing crossed dominance, meaning that significant number of people with a dominant right hand also had a dominant left eye.

The previous studies have shown that right eye dominance was greater than the left eye dominance.^[13,14] This is in similar lines with the present study. In humans, the right brain hemisphere is dominant in visuospatial and non-verbal function whereas the left cerebral hemisphere is dominant in recent verbal functions.^[3] Dominance is described as physiological priority or preference by one member of any bilateral pair of structures in the body when executing various activities, and is mostly controlled by genetics. The neurological inhibition of the recessive hand allows the dominant hand to develop precise, corrective, rapid movement without interference from the non-dominant hand. People who have a dominant right hand use their right hand predominantly as a worker hand.^[15] Few studies have investigated the relation between hand and eye preference. In a study by Aswathappa *et al.*^[14] conducted on medical students reported similar findings of 26% of cross-dominance but concluded that there was no significant relation between dominant eye and dominant hand. The study also showed that Miles test was more significant than questionnaire method to determine ocular dominance. Robison *et al.* study showed that 43.5% of the general population exhibit cross-dominance.^[16] In his study, Portal and Romano found that pitchers with uncrossed eye hand dominance were marginally more effective than those with crossed eye hand dominance. Batters with crossed eye hand dominance were considerably more successful than batters with uncrossed eye hand dominance. The pattern of eye hand dominance appears to be linked to baseball athletic ability.^[17]

The tendency to prefer visual input from one eye over the other is known as ocular dominance. It is similar to right or left handedness in that the dominant eye and dominant hand are not always on the same side. This is because both hemispheres control both eyes, but each one takes charge of a different half of the field of vision and therefore a different half of both retinas. There is thus no direct analogy between “handedness” and “eyedness” as lateral phenomena.^[15] This cross-dominance could also be crucial in games requiring aim, such as archery, darts, or shooting sports. Patients’ satisfaction with monovision correction in cataract surgery,^[18] refractive surgery, laser eye surgery, and contact lens wear is likewise influenced by ocular dominance.^[19] As a result, several authors regard eyedness as a more fundamental indicator of underlying laterality. Crossed eye hand dominance is a warning sign that a child is being taught to write with the less biologically suited hand. Bishop showed marginal evidence of an increased incidence of crossed dominance in children with reading difficulties.^[20] If eye and hand, for example, have inverted dominance (right handedness and left eyedness), there is likelihood for reading learning difficulties.^[21] A completely organized child is believed to have a dominant hand and eye on the same side. There is a degree of neurological disorganization if there is no complete dominance. Subjects with cross-dominance (where a subject’s eye and hand dominance do not match, for example, having left eye dominance with right hand dominance) will be unable to process the information because they lack organization.^[22] Ocular dominance plays an important role in visual memory.^[23] Due to a lack of firm pathways in the brain, they are unable to take in information, integrate it, analyze it, and bring it out again when given a task. Such individuals will have difficulty with visual memory, resulting in learning difficulties.^[22,23]

Eye dominance is a neglected element of human lateralization, and hence, its association with handedness has to be studied in depth in educational system so that some of the learning difficulties can be analyzed and corrected at the earliest. There are minimal studies done to assess the association between handedness and ocular dominance, especially in medical undergraduates. Hence, this study adds on to the current literature studies with its findings in cross-dominance and can form a basis for future studies. Limitations of the study are small sample size which was limited to only Phase II MBBS students. Refractive errors which influence ocular dominance, gender differences, and learning difficulties were not assessed.

CONCLUSION

Study concludes that there exists a significant association between dominant hand and dominant eye wherein 26% of subjects showed crossed dominance. Evaluating eye hand dominance or crossed dominance might be helpful to assess

learning difficulties and also helpful in young players or athletes that allow them to choose whether to hit with their left or right hand or to swap hits. This is a crucial topic for laterality research in the future.

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