

A comparison study between left-handed and right-handed dominant individuals regarding the prevalence of discomfort after a sustained period of writing in high school and undergraduate students

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Abstract

OBJECTIVE: The purpose of the study was to understand the prevalence of discomfort in college-going students after sustained periods of writing in left and right-dominant individuals.

METHODS: The research was conducted through a cross-sectional study design using a survey method. The tool of the survey was a self-made questionnaire validated by 2 field experts. The data was then analyzed and presented graphically.

RESULTS: It was observed that individuals with both dominances have the palmar area as their dominant pain site. Right-handed individuals reported having more incidences of upper Trapezius pain when compared to left-handed individuals. Left-handed individuals reported pain over the radial aspect of the forearm.

It was also reported that left dominant individuals were not able to complete their writing activity more often due to pain as compared to right dominants.

CONCLUSION: Right-handed individuals had more complaints of pain whereas left-handed individuals had discomfort with respect to legibility, environmental factors like improper desk ergonomics etc.

Keywords: left-handed and right-handed dominant individuals, high school and undergraduate students.

Introduction:

Laterality is the organization of the brain that creates representations of certain functions on a particular side or hemisphere of the brain. The common form of laterality in humans is the one where the left side of the brain is dominant making the human being right-handed. However, there is a certain percentage of the population that is left-handed. Research over the years has revealed a few other types of literalities where such hemispheric dominance is either absent leading to asymmetrical qualitative distribution of functions or the distribution is disorderly leading to Dyslaterality. Ten percent of the human population is left-handed. Researchers are still trying to find the exact cause of left-handedness. Many theories have come into the picture in recent times regarding why a person maybe left-handed. The following are the gist of theories:

A) The genetic theory: there is increased chance of left-handedness in the offspring if both parents are left-handed individuals. The human left handed minority has persisted for thousands of years therefore it is reasonable to assume that gene for left handedness has survived.

B) Sex: Males tend to be more left handed with respect to females.

C) Injury to the brain: Researchers believe that all humans should be right handed, but due to an injury during antenatal period or perinatal period makes a person more susceptible for left handedness.

D) Modelling: Infant chooses the dominance copying the parents or the caregiver.

The activity of writing is almost performed by every individual regardless of the dominance. Matured writing develops around 4-5 years of age where a child is required to start writing a three or a four letter word. The time period where the writing activity is most concentrated is found to be in high school students [junior college], during an undergraduate course and in post-graduation. The writing activity drastically increases in intensity as well as in duration due to academic demands in the form of assignments and examinations. Writing requires high precision and sustained muscle work depending on the grip type preferred by the individual. Dynamic tripod is most commonly used grip type. The metacarpophalangeal joint and proximal interphalangeal joint are partially flexed and distal interphalangeal joint being extended or slightly flexed. Most muscle work is concentrated in the flexor digitorum superficialis, flexor digitorum profundus. There is continuous activity in the interossei. The thumb is kept in flexion abduction and opposition requiring activity of the thenar musculature along with flexor pollicis longus. Dynamic quadrupod is also called the three jaw chuck requires the thumb, the index finger along with the middle finger. The muscle work remains same as dynamic tripod along with flexor activity that is flexor digitorum superficialis and flexor digitorum profundus of the middle finger.

Lateral tripod demands more of adduction and less opposition of the thumb. The activity in flexor pollicis brevis muscle increase and opponens pollicis decreases when compared to dynamic tripod. Activity of the adductor pollicis also increases. There is continuous activation of lumbrical muscles to keep the metacarpophalangeal joint in flexion along with long flexors of the phalanges to maintain flexion at proximal interphalangeal joint. Lateral quadrupod demands similar activity with respect to lateral tripod along with activity of middle finger along with thumb and the index finger.

Regarding the writing ergonomics a study done in honk kong, ball point yields the fastest and ink pens yield the lowest speed while writing. Writing pressure was highest with ball pens and lowest with felt tip pens. It also concluded that

large diameter pens had low comfort and low writing ability score. Large diameter pens may affect the writing activity if continued for a sustained period of time.

The current study aims to understand the discomfort faced by individuals who write with left hand as compared to those who write with right hand during prolonged writing. Since the script of most of the languages are read and written from left to right, a practical challenge faced by left handed individuals is to be able to see what is written while proceeding the writing. This may cause them to develop a grip style that may not be ergonomically efficient. Many of the chairs in the academic setup are designed in a way that allows support for the right arm but not for the left. Thus we hypothesized that challenges posed by the contextual factors may precipitate discomfort in people with who write with left hand. Based on findings we wish to give recommendations towards following certain exercises modifying the resources being used to alleviate discomfort, to prevent further impairments and to improve the quality of writing activity.

Methods

A written consent was taken from the participants before commencing the study. The research design was cross sectional survey design where a self-made questionnaire was made that was validated by two field experts. The study subjects were healthy young adults under the age group of 17-23 years. They were excluded if they had any long standing co morbidities or recent [less than a month] upper limb injuries. The responses from the questionnaire were analyzed and represented statistically. Recommendations were given based on the responses.

The survey questionnaire covered the following domains:

1. Orientation of the book preferred by left v/s right handed individuals
2. Palm position adopted by right v/s left handed individuals
3. Grip type used by the subjects
4. Difficulty faced by right v/s left handed individuals while writing on a particular page
5. Type of book, pen and pen grip preferred by the subjects
6. Difficulty in completing the exam paper
7. Areas where pain was experienced by the left and right handed individuals
8. Areas where they had maximum pain
9. Need for and availability of an external support while writing
10. Difficulty in copying notes from the board
11. Neatness and legibility of writing with equal spacing of words
12. Pressure exerted while writing

Results

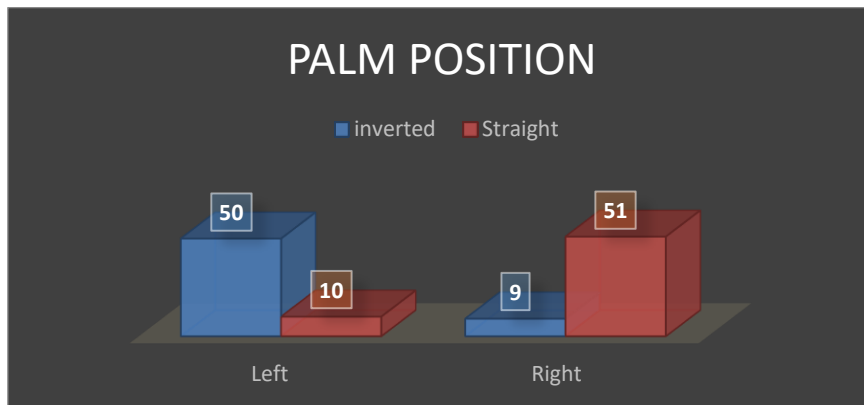


Fig 1 Thus a considerably higher number of Left handed individuals have an inverted palm position while writing.

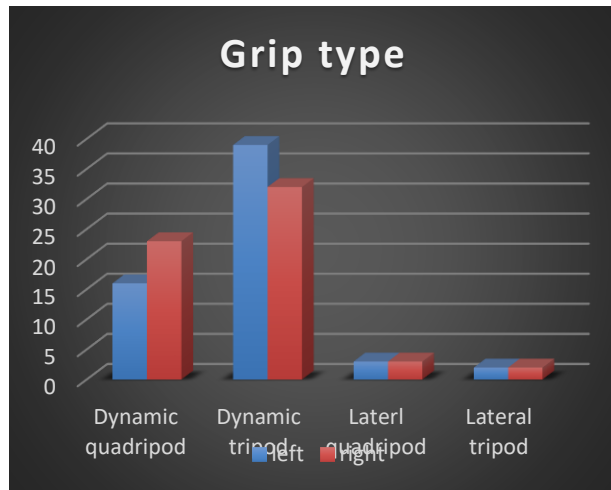


Fig. 2

It was observed that 26 percent of left handed population and 38 percent of right handed population has a grip type of dynamic quadripod. It was observed that 65 percent of left handed population and 53 percent of right handed population have dynamic tripod grip type.

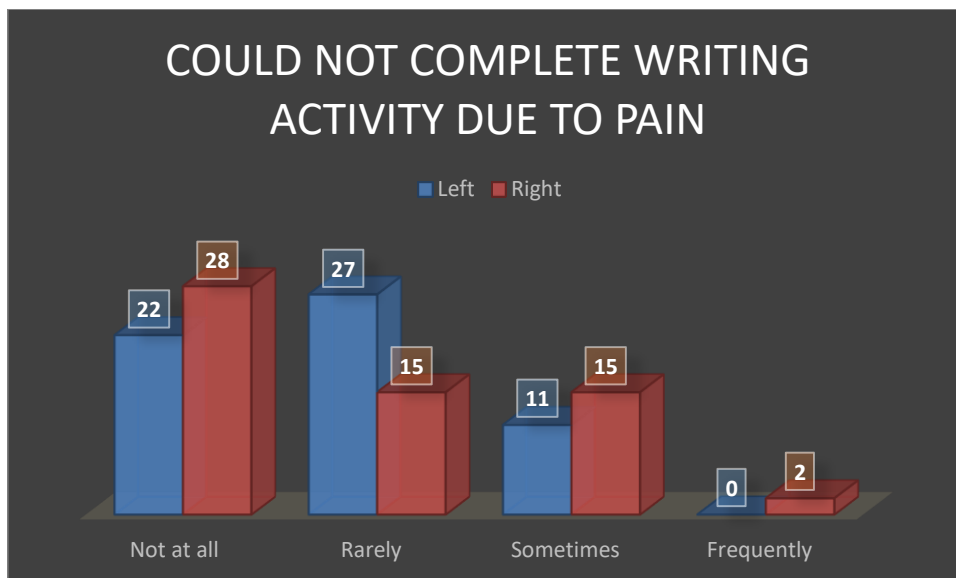


Fig 3. Thus there are greater number of left handers who have experience of inability to complete an examination paper due to pain.

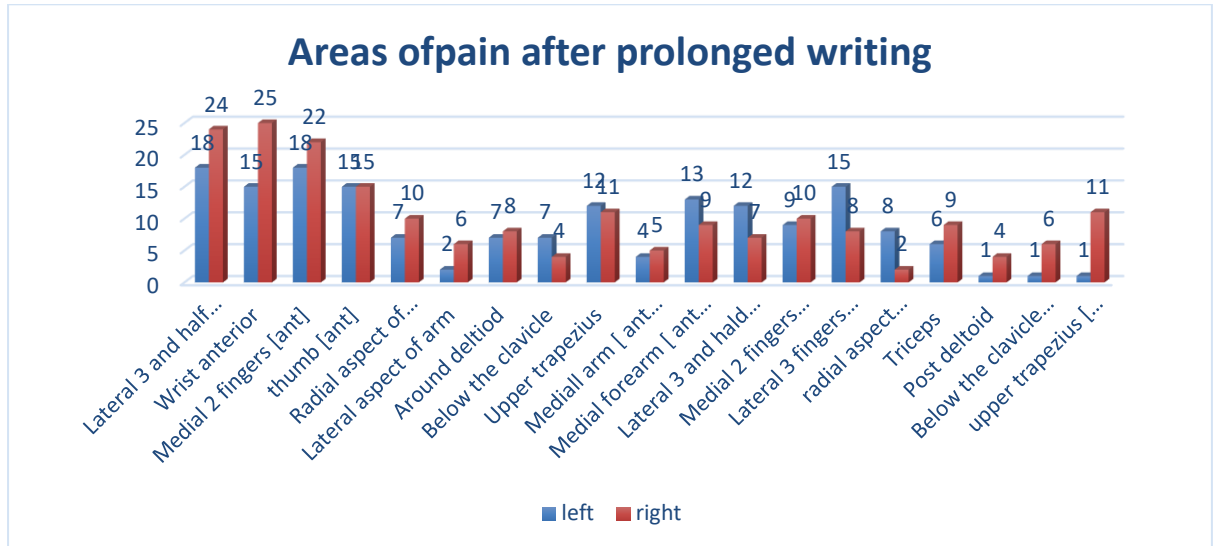


Fig. 4: It was observed that 30 percent of left handed population and 40 percent of right handed population have pain in lateral 3 and half fingers on the anterior side.

It was observed that 25 percent of left handed population and 41 percent of right handed population have pain on the anterior side of the wrist.

It was observed that 30 percent of left handed population and 36 percent of right handed population have pain in medial 2 fingers on the anterior side.

It was observed that 25 percent of right and left handed population had pain at the thumb on the anterior side.

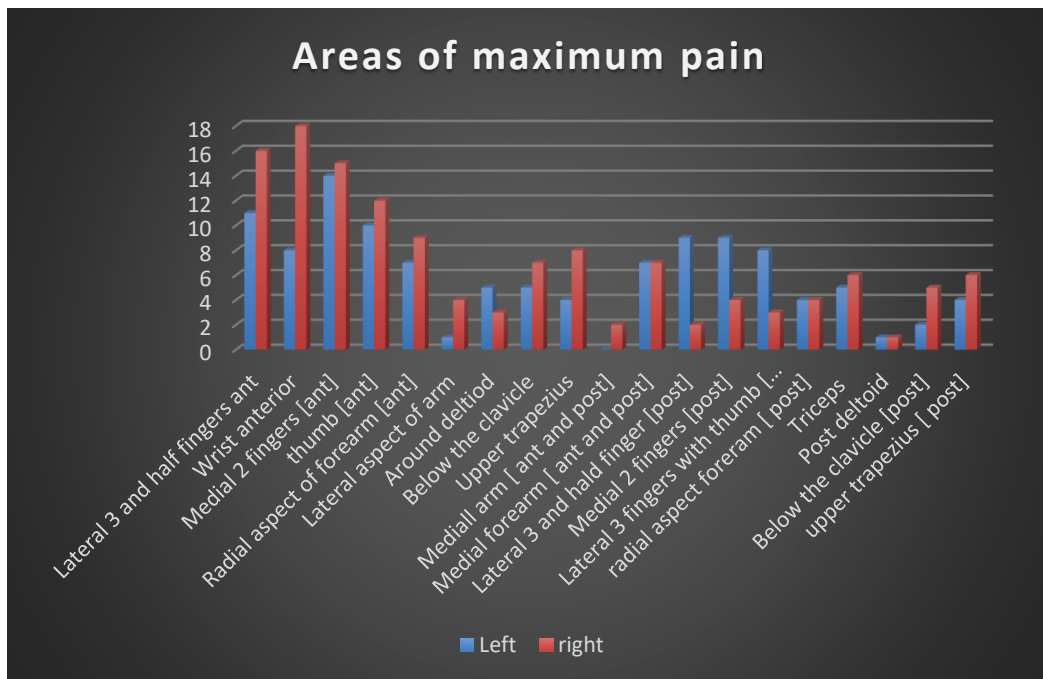


Fig5: Thus the areas which seem to become painful include lateral and medial fingers, anterior wrist joint, lateral or radial aspect for forearm. More number of left handed individuals are found to have discomfort in the medial 2 fingers than the right handed individuals, whereas the number of individuals reporting pain in the other areas is more among right handed individuals as compared to left handed individuals.

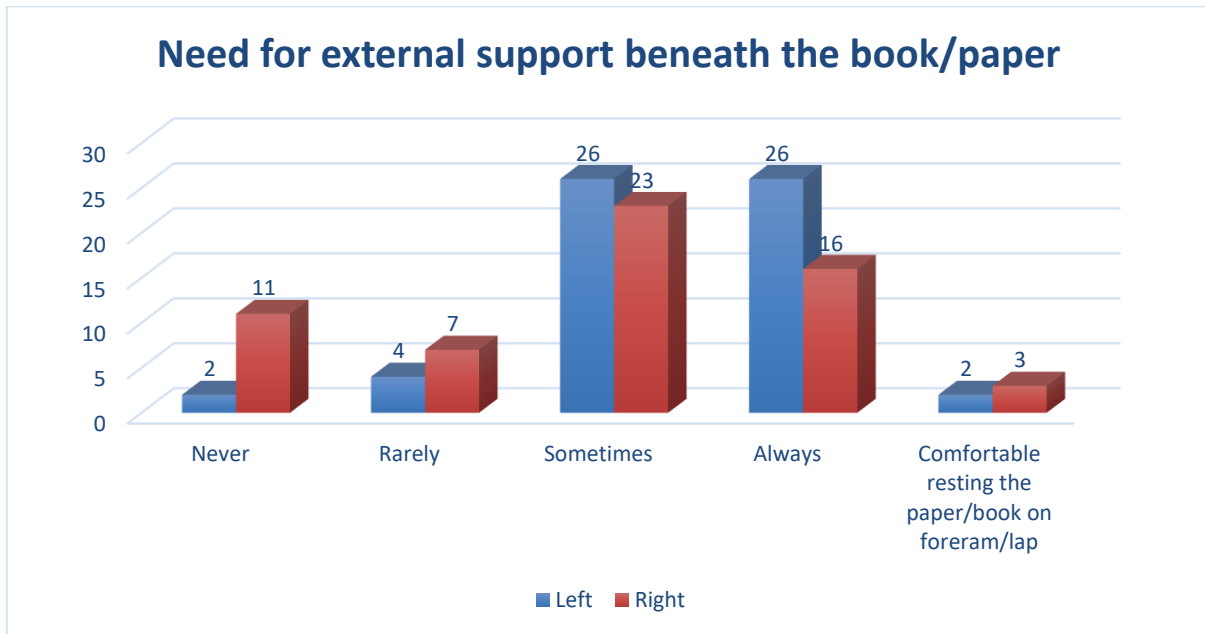


Fig 6: Thus more number of left handed individuals as compared to right handed individuals express need for a support beneath the book.

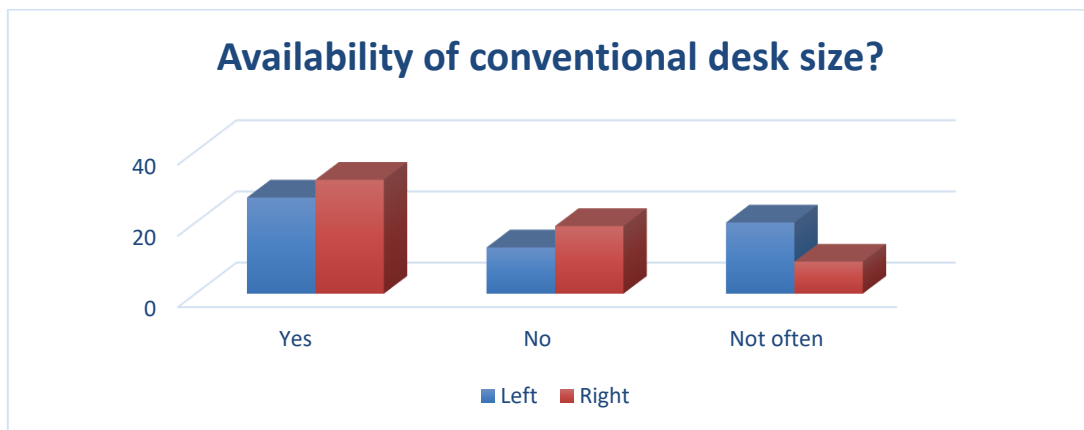


Fig 7: It was observed that 45 percent of left handed population and 54 percent of right handed population feel that conventionally available desk size is appropriate.

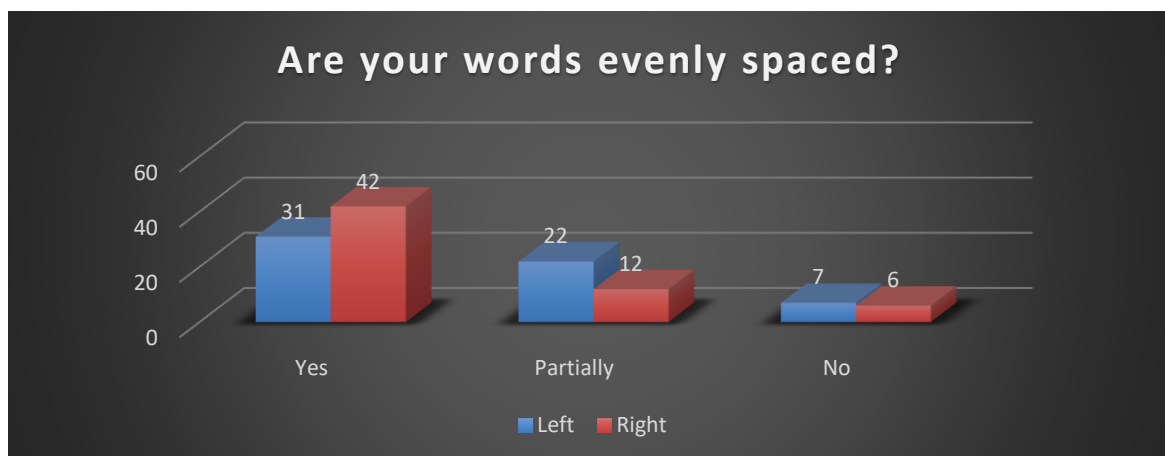


Fig 8: It was observed that 57 percent of left handed population and 70 percent of right handed population have proper spacing between words.

Thus more number of left handed individuals as compared to the right handed individuals say that the words are partially or not equally spaced.

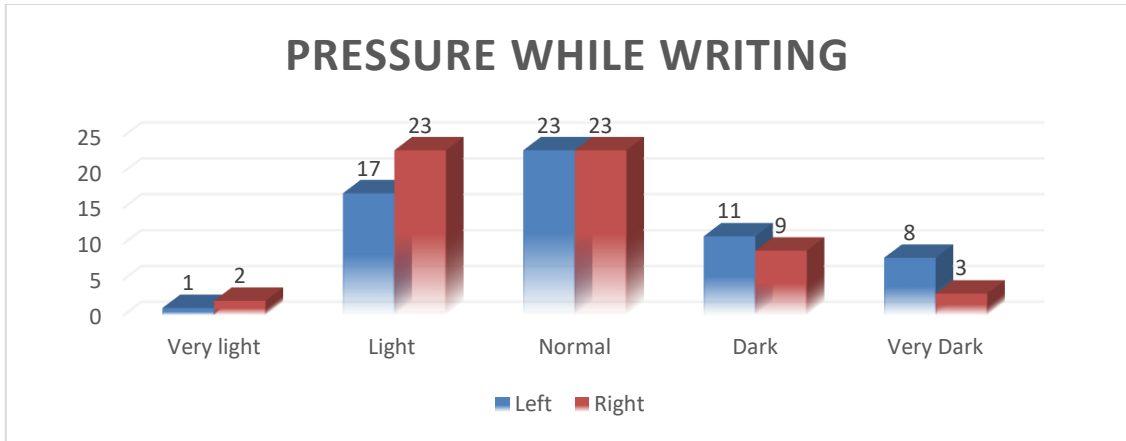


Fig 8: It was observed that 13 percent of left handed population and 5 percent of right handed population tend to apply very dark pressure while writing.

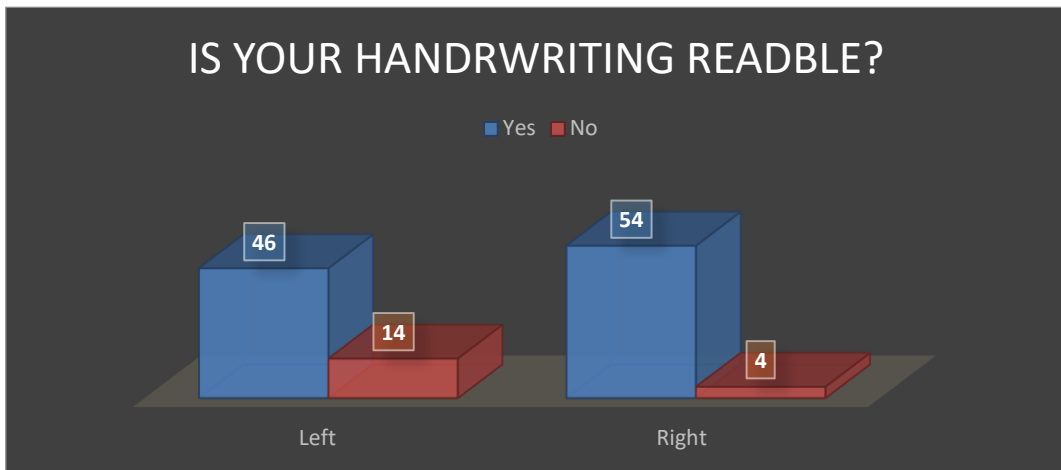


Fig 9: Thus there are more number of left handed individuals who say that the handwriting is not readable

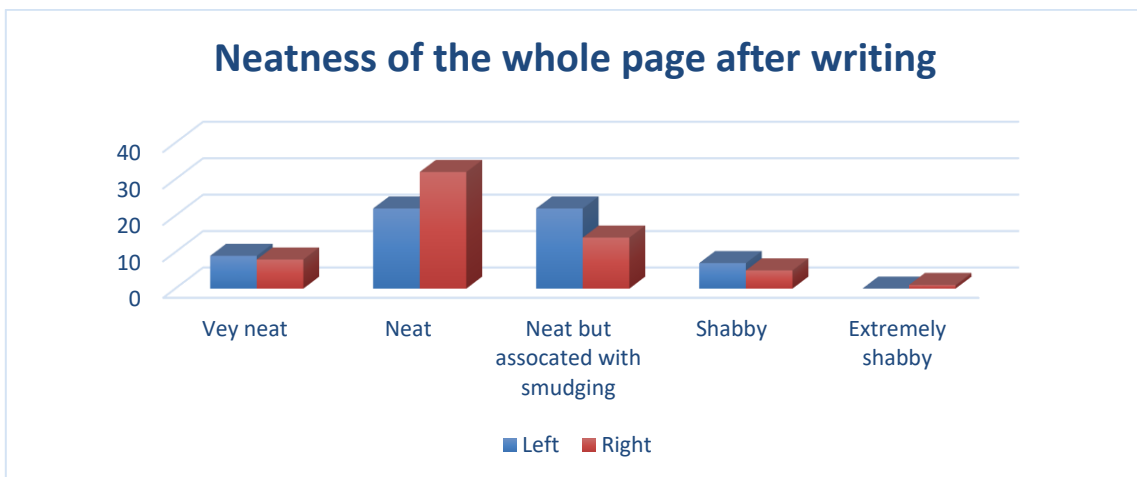


Fig: 10 Thus slightly greater number of left handed individuals as compared to right handed individuals have said that the handwriting is either shabby or involved smudging.

Discussion

Pain associated after sustained periods of writing: It was observed that majority of people of both dominances had pain around lateral three and half fingers anteriorly, anterior part of the wrist and medial 2 fingers on the anterior side. Therefore the whole palmar area was dominant pain site regardless of the dominance. It also came into picture that right handed individuals tend to have more upper trapezius pain as compared to left handed. It was also noticed that

more left handed people experience pain around the radial aspect of the forearm when compared to right dominant individuals. Most of the right handed dominant individuals experienced maximum pain around the volar aspect of the palm whereas left handed dominant population experienced maximum pain around the medial 2 fingers that is the thumb and the index finger. (ring finger and little finger)

It was found that more amount of left-handed population experienced ‘Moderate pain’ when compared to right-handed individuals. Type of pain was also variable given relatively more amount of left dominant population experienced the feeling of heaviness in the extremity when compared to the right. It was also found that left-handed dominant individuals relatively could not complete writing activity due to pain.

Choice of resources:

It came into notice that most left-handed and right-handed dominant individuals tend to orient the book/paper towards their left side with respect to the trunk. Most of the left-handed population have an inverted palm position while writing whereas the right dominant had a straight palm position. It is also important to note the position of the wrist during a sustained period of writing such as in inverted position the wrist goes more into flexion which alters the length-tension relationship between the flexors and extensors of the forearm which may lead to

Sub-optimal muscle forces are required to sustain a good quality of writing. It may also lead to compression of the median nerve which may eventually bring sensory symptoms and thenar muscle weakness necessary for writing. Passive insufficiency in the extensor tendons due to more wrist flexion causes unnecessary strain on the tendons and can be a cause of pain in the future leading to decreased endurance or quality for writing.

The majority of individuals [i.e both left and right dominant individuals] chose dynamic tripod as their grip type with the left-handed population having more dominance to the right.

It came into the picture that most right-handed dominant individuals had mild to moderate difficulty in writing on the lower half of the left page whereas the left-handed dominant population had mild to moderate difficulty while writing on the lower half of the written page. A simple technique to overcome this difficulty could be rearranging the book to bring it in the center of the desk/table or towards the upper right side which is noted as the most comfortable part of the page to write. This placement will not only make the writing easier but will also allow better hand placement for the individual.

The majority of the left-handed population preferred the use of nonspiral books over spiral ones. The probable biases towards this might be contributed to the lack of stable hand placement due to the spiral bound therefore increasing the need for proximal stability therefore increasing the overall muscle work.

When type of pen preference was analyzed it was noted that most of the individuals regardless of the dominance preferred ball pen followed by gel followed by ink pen. Preferred thickness of the grip for both dominances came out to be medium followed by thin and lastly followed by thick grip.

It was observed that majority of left handed population required an external support to keep the book/paper on when compared with right dominant individuals and were not comfortable with resting the book/paper on the lap or forearm when external support could not be available. It also came into notice that majority of left handed dominant had tendency to bend while writing irrespective of the desk height. Continuous stooped posturing while writing can

lead to back pain due to imbalance between trunk flexors and extensors. So proper trunk alignment could be one of the component of patient education and could be instilled when the child starts writing activity regardless of the dominance.

It came into light that majority of left handed dominant population do not find the desk size appropriate that is conventionally available to them. It was found from the feedback replies that the desk size could be increased to have a proper support to the extremity.

Quality of writing:

It was observed that a huge chunk of left handed population had difficulty in spacing of words evenly. Right handed population tend to have a more legibility when it comes to writing. Talking about rating the neatness of the whole page a lot of left handed dominant population rated shabby and was associated with smudging.

Spacing of words depend on visuospatial cognition as well as motor praxis and co-ordination. A theory says that for left handed individuals who are left handed, the natural scrolling of space from left to right is challenging, and hence left to right scrolling using smooth pursuits is something that they need to adapt gradually. Thus there maybe difficulty associated with planning of space management while writing with in left handed individuals. Left handed

individuals are found to assume inverted hand positions while writing. In this position, the arm moves away from the body and the scapular muscles may assume a lengthened position. With less stability at proximal segments, the precise choice of fine motor control is challenging. This may reflect in the form of handwriting that is perhaps unpredictable and hence illegible at times.

Discussion about the open-ended questions:

Most left-handed dominant population gave the concern of not having an ergonomically designed chair that has a foldable deck towards the left leading to the increased amount of trunk flexion along with rotation to the right to reach the desk. It would be appropriate to have some left-handed ergonomic chairs in a class for the left-handed dominant individuals.

It was also raised by the left-handed population that the breadth of the desk should be increased to have a proper resting area to stabilize the dominant hand while sustaining writing. Suggestions about positioning the left-handed individual also came to light. It was recommended that left-handed dominant individuals should be placed such that there is no obstruction to the left hand like a wall or some other person sitting on the left side. Keeping an arm distance between two individuals can make the writing activity more efficient and

Obstruction-free. For the right-handed dominant individuals, the major concern was to increase the desk height and size so that the forearm can be rested fully during periods of sustained writing. It was also raised to increase the distance between the chair and the desk so that individuals can change positions and have the space to stretch the upper extremity and lower extremity.

Conclusion:

Right-handed dominant individuals had more complaints of discomfort with respect to pain whereas left-handed individuals had discomfort with respect to legibility, improper desk ergonomics. Right-handed dominant individuals overall had more diverse and anatomically spanned locations of pain as compared to left-handed individuals. The left page lower half area poses to seem the greatest challenge for both dominances. The upper half of the page seems to be easier for both dominances to write.

To improve the quality of writing in left-handed individuals in terms of legibility, training of the scapular musculature to increase proximal stability can be prescribed to attain better motor control while writing. To deal with pain arising after a sustained period of writing a good amount of warmth and cool down of the hand and forearm musculature can prevent injuries associated with prolonged writing along with alleviating the pain. To prevent or minimize the risk of discomfort while writing, training the child in his/her childhood with an emphasis on proper palm orientation, the position of the trunk can be helpful.

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