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Original Article

Physiology Section

Bimanual Coordination: Influence of Age and Gender

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ABSTRACT

Introduction: Bimanual hand coordination is very important in carrying out day to day activities like buttoning the shirt, driving, picking up objects. It depends on various factors like age, gender, education, intactness of central and peripheral nervous system, Occupation and lifestyle.

Aim: The aim of the study was to compare the efficiency of bimanual hand coordination between right handed male and female subjects and to correlate efficiency index with age of those subjects.

Methods: The study group included 60 right handed healthy male and 60 right handed healthy female subjects of age group between 11-60 years. Institutional ethical clearance and Informed consent from subjects was taken. The efficiency of bimanual hand coordination was assessed by the use of bimanual hand coordination test apparatus with electrical chronoscope. The time (T) taken for completion of the task and the error (e) committed was recorded by the chronoscope and efficiency index (E.I) was calculated as E.I= (T-e)/T *100.

Results: The mean age of males was 32 ± 11 years and females were 32 ± 13 years. The efficiency index of males (95.08 ± 5.24) was significantly higher than females (92.16 ± 6.69) with p value <0.005. Negative correlation of efficiency index with age was observed (r=-0.343, p=0.0001). It was concluded that bimanual hand coordination was better in males as compared to females and the efficiency index decreases with age in these subjects.

Conclusion: The present study showed that males have better bimanual coordination when compared to their female counterparts and aging causes decline in efficiency of bimanual coordination.

Keywords: Bimanual hand, Coordination, Corpus callosum

INTRODUCTION

Bimanual hand coordination is very important in performing daily activities like eating, dressing yourself, driving, etc. Coordination of the hands and fingers is likely to rely on communication through the corpus callosum [1-3]. Producing coordinated two-handed movements requires precise timing between the limbs which is influenced by various factors like age, handedness and gender [4-6]. The contribution of the corpus callosum to bimanual coordination is well-established [7,8], particularly the anterior fibers [9].

With aging there is slowing of motor performance and that older individuals show decreased motor output with relation to speed, coordination of limb movement, or balance compared to younger adults [4,10-12]. Information on the influence of gender in motor performance is a noted clinical finding but not well-established.

The present study was undertaken with the aim of analyzing the possible influence of age and gender on efficiency of bimanual hand coordination.

METHODS

The present study was conducted at department of physiology Sri Devraj Urs Medical College, Kolar, India after taking institutional ethics clearance. The study group included randomly selected 60 right handed healthy males and 60 right handed healthy females of age group between 11-60 years. Subjects with known history of motor, behavioural, orthopaedic, learning difficulties or neurologic deficits and primary uncorrected visual deficit or medical condition that might interfere with their ability to carry out motor task were excluded from the study. After taking informed consent participants were subjected to clinical examination of sensory and motor system. The efficiency of bimanual coordination was assessed by the use of bimanual hand coordination test apparatus with electrical chronoscope (Anand agencies, Pune, India).

The subjects were asked to trace the figure on the apparatus with the help of the pointer from start to end using two handles. If the pointer touches the walls of figure on the apparatus it was noted as error (e) committed and was digitally recorded by chronoscope in seconds. They were given trial twice before the actual task was to be performed. Time required for completion of the test (T) and error (e) committed during completion of task was noted in seconds. Efficiency index, E .I= (T-e)/T *100 was calculated accordingly.

STATISTICAL ANALYSIS

Two tailed independent student t-test was used to find the significance in efficiency index between male and female subject groups. Significance was also assessed at 5% level of significance. The correlation between age and efficiency of bimanual hand coordination was done using Pearson correlation co-efficient and significance was assessed at 1% level of significance.

RESULTS

The mean age of males was 32 ± 11 years and females was 32 ±13 years and are age matched with p-value >0.005. The efficiency index of males (95.08 ± 5.24) was significantly higher than females (92.16 ± 6.69) with p value <0.005 [Table/Fig-1]. Negative correlation of efficiency index with age was observed with r = -0.343, p-value 0.0001.

	Males	Females	p-value
Efficiency Index (Mean ± SD)	(95.08 ± 5.24)	(92.16 ± 6.69)	<0.005

[Table/Fig-1]: Comparision of efficiency index of males (n=60) and females (n=60)

DISCUSSION

We rely on bimanual coordination for our day to day activities to be carried out smoothly. The efficiency of this bimanual coordination is dependent on the integrity of corpus callosum which helps in communication between two hemispheres of the brain. Corpus callosum plays a major role in coordinating motor activity from opposite sides of the body; deficits in bimanual coordination have been documented in individuals with agenesis of or damage to

the corpus callosum [13,14]. Efficiency of bimanual coordination is influenced by age, gender, handedness, occupation.

Aging causing a global decline in motor performance is a documented clinical finding [4,5,15] Present study also shows age related decline in efficiency of bimanual coordination. Evidence shows that aging is linked to decreased size and integrity of the Corpus Callosum [16]. Alternatively, aging may lead to deterioration in some common factor such as processing speed or inhibitory control that subsequently results in global declines across bimanual coordination tasks [17,18].

In some studies, MRI investigations suggest that the corpus callosum does not undergo extensive volumetric declines with age [19]. Interhemispheric communication can have either net facilitatory or inhibitory effects on the cortex [20]. Interhemispheric interactions require a balance between excitatory and inhibitory processes; and studies suggest that this overall balance is likely shifted in the aging brain [21].

In line with reductions in interhemispheric inhibitory interactions with age, accumulating evidence demonstrates reduced inhibition within the nervous system of older adults, both at the cortical [22,23] and spinal levels [24], also contribute to the decreased efficiency of coordination with aging.

Age related decline in coordination may also be attributed to changes downstream from the cortical and subcortical motor structures like decline in muscle mass and strength seen in older human subjects [25,26] and loss of anterior horn cells has been reported in older animals [27].

Various studies have demonstrated that bimanual coordination was significantly predicted by age & gender [4,5]. Present study shows significant difference in efficiency of bimanual coordination between males and females. Sex differences in human cognitive and motor skills may in part be due to organizational or activational effects of sex hormones on the brain [28]. Researchers have also documented sex differences in corpus callosum morphology in both area and regional subdivisions in humans [29]. Animal based study done on capuchin monkeys shows adult females have larger corpus callosum,brain volume ratio, rostral body than their male counter parts [30].

Estrogen has a neuroprotective effect on the central nervous system, efficiency of motor performance changes with different phases of menstrual cycle, high levels of gonadal steroids present at the luteal phase of the cycle may facilitate skills favoring females [31].

LIMITATIONS

In our study the sample size is very small and to project these results to general population larger samples have to be studied and also the various phases of menstrual cycle and their possible effect on the performance in females needto be studied.

CONCLUSION

The age-related change in corpus callosum morphology and decline in interhemispheric inhibition may be associated with decrease in efficiency of bimanual coordination with aging. Study also concludes that males have a better bimanual hand coordination when compared to their female counterparts which may be due to effects of gonadal steroids on central nervous system. Further work is required to know the possible effect of different phases of menstrual cycle on bimanual coordination in females.

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