

## YOGA TRAINING AND MOTOR SPEED BASED ON A FINGER TAPPING TASK

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**Abstract :** A finger tapping task was used to assess motor speed (MS) of both hands in 53 adults and 152 children before and after yoga training and in 38 adults of a non-yoga (control) group. All subjects were right hand dominant. The 30-second tapping speed (TS) test was considered as three time intervals, i.e. 0-10 second (TS1), 10-20 seconds (TS2) and 20-30 seconds (TS3). There was a significant (Student's t-test) increase in all three TS values following 10 days of yoga in children and 30 days of yoga in adults. However for both groups at baseline and final assessments, TS2 and TS3 were significantly lower than TS1. Hence the TS was increased after yoga training during the first 10-seconds of the test but not during the next 20 seconds. These results suggest an increase in motor speed for repetitive finger movements following yoga training, but not in strength or endurance, as the increase was not sustained over 30 sec.

**Key words :** repetitive movements      finger tapping      fatigue

### INTRODUCTION

The frequency of successive, rapid alternating movements has been a standard measure to clinically evaluate one aspect of motor function, viz. motor speed (1). Finger tapping is one such example, where the number of taps in a given time is an index of the speed of motor activity. Motor speed has been shown to increase with age in childhood (2), while the reverse is true in adulthood, and males perform better than females (3). Speed of manual motor activity quite obviously varies with handedness, the dominant hand having a faster rate (4).

A comparison of right versus left hand motor speed is referred to as motor speed asymmetry (5). Unilateral motor speed appears to be more lateralized than various cognitive abilities, and there is believed to be a close association between right or left hand tapping speed and the activity of the left or right hemisphere respectively.

The present study aimed at assessing the affects of yoga training on finger tapping speed, with subjects categorized according to age and gender.

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## METHODS

### Subjects

There were 91 adults (53 received yoga training, while 38 belonged to the control group). The control group had no experience of yoga, and were selected within the same age range as the yoga group to evaluate the effects of retest on motor speed. No other factors were considered. Matching of subjects individually was not possible as there were different numbers of subjects in the two groups. The age range and group mean values  $\pm$  SD of the two groups were as follows: experimental group (adults, yoga): 20–50 years, group average  $\pm$  SD, 28.2  $\pm$  7.6 years, control group (adults, non yoga): 20–50 years, group average  $\pm$  SD, 29.9  $\pm$  6.8 years. Assessments were also made in 152 children (group average age  $\pm$  SD, 14.2  $\pm$  1.3 years, 67 girls), who learned yoga. All the subjects were right hand dominant, based on standard questions (e.g. the hand used to write, comb, throw a ball).

### Design of the study

Assessments on adult subjects were made at the beginning (initial) and end (final) of a 30 day period during which the yoga group (n=53) received training in yoga, while the control group (n=38) carried on with their routine activities. Assessments on the 152 children were carried out at the beginning (initial) and end (final) of 10 days of yoga.

### Apparatus

The tapping board (Anand Agencies, Pune, India), consists of a wooden plank

raised on one side by an angle of approximately 8° to the horizontal, providing an inclination on which the wrist could rest while tapping. Tapping would depress a metal bar, connected to a counter, so that each tap would increase the reading by '1'. The counter could be manually reset to zero.

### Procedure

Subjects were asked to tap the metal bar as many times as possible during a period of 30 seconds. Assessments were made for both hands, the right was tested first followed by the left hand, with a gap of 10 seconds, in between. The number of taps was noted at the end of 10, 20 and 30 seconds, as the Tapping Speed, i.e., TS1, TS2 and TS3.

### Training in Yoga

The yoga groups received yoga training for approximately 8 hours a day, which was aimed at all round (physical, mental, intellectual, and spiritual) development. The 10-day program for children and 30 day program for adults had certain similarities. These programs consisted of: (i) yogasanas, specialized physical postures which are meant to increase physical stamina and mental balance; (ii) pranayama or voluntary regulation and slowing of the breathing which is carried out to achieve a relaxed state of mind and to increase inner awareness; (iii) kriyas, techniques which bring about cleansing of the eyes and internal organs (e.g., respiratory tract, abdominal muscles, and some other viscera); and (iv) devotional sessions. In addition to these specialized practices, the training for

children also included games to improve the attention span and memory as well as the telling of meaningful stories to foster a sense of values and feelings of responsibility.

#### Data analysis

The data were analysed in three ways: (a) The baseline changes in tapping speed from initial to final assessments were calculated comparing tapping speed in 0–10 seconds (TS1), 10–20 seconds (TS2) and 20–30 seconds (TS3) on Day 1 and Day 30 (adults) and Day 1 and Day 10 (children) using Student's t-test. (b) To see the effect of time on tapping speed, the tapping speed between 20–30 seconds (TS3) and 0–10 seconds (TS1) of the same day were compared using Student's t-test. This was done separately for initial and final assessments. (c) The Motor Speed Asymmetry (MSA) was calculated, i.e.  $MSA = \{[Right\ hand\ speed - Left\ hand\ speed] / Right\ hand\ speed\} \times 100$  (5). The MSA values at initial and final assessments

were noted though they were not tested statistically for significant difference.

## RESULTS

Group mean values  $\pm$  SDs are provided in Table I.

*Baseline changes in tapping speed from initial to final assessments were calculated comparing tapping speed in between 0–10 seconds (TS1) 10–20 seconds (TS2) and 20–30 seconds (TS3).*

All adults of the yoga group showed significant increases in TS1, TS2 and TS3 of both hands after 30 days of yoga compared to before (Student's t-test). The percentage change and levels of significance are mentioned in Table II. Adults of both sexes belonging to the control group showed no change. Children of both sexes showed significant increases in all three groups (TS1, TS2 and TS3) of both hands at final assessments after 10 days of yoga, compared to initial assessments (Table II).

TABLE I : Tapping speed in subjects during 0–10 seconds (TS1), 10–20 seconds (TS2) and 20–30 seconds (TS3). Values are group means  $\pm$  S.D.

Subject	Sex	Category	Hand	Initial			Final		
				TS1	TS2	TS3	TS1	TS2	TS3
Adults (n=53)	M (n=43)	Yoga	R	43.2 $\pm$ 9.2	41.8 $\pm$ 8.2	41.2 $\pm$ 8.9	51.1 $\pm$ 9.5	47.0 $\pm$ 7.8	45.7 $\pm$ 9.7
			L	40.1 $\pm$ 8.8	37.0 $\pm$ 8.6	35.2 $\pm$ 8.6	47.1 $\pm$ 9.8	42.9 $\pm$ 7.9	40.3 $\pm$ 9.4
	F (n=10)	Yoga	R	37.8 $\pm$ 9.3	34.8 $\pm$ 7.3	31.9 $\pm$ 6.0	52.5 $\pm$ 9.3	46.8 $\pm$ 8.7	43.3 $\pm$ 6.0
			L	36.0 $\pm$ 10.3	33.9 $\pm$ 7.8	27.7 $\pm$ 4.5	48.2 $\pm$ 6.6	41.0 $\pm$ 6.2	36.1 $\pm$ 8.6
Adults (n=38)	M (n=21)	Control	R	51.7 $\pm$ 7.5	48.6 $\pm$ 8.6	47.4 $\pm$ 1.9	53.9 $\pm$ 6.9	50.2 $\pm$ 8.4	47.1 $\pm$ 8.0
			L	48.8 $\pm$ 7.9	43.9 $\pm$ 6.9	39.1 $\pm$ 9.8	51.1 $\pm$ 8.2	45.4 $\pm$ 6.4	36.6 $\pm$ 6.4
	F (n=17)	Control	R	38.4 $\pm$ 7.4	38.2 $\pm$ 7.9	32.1 $\pm$ 8.0	38.3 $\pm$ 9.6	37.6 $\pm$ 9.3	30.4 $\pm$ 8.4
			L	36.6 $\pm$ 7.6	32.9 $\pm$ 7.7	31.9 $\pm$ 7.8	36.8 $\pm$ 9.5	32.9 $\pm$ 8.3	27.1 $\pm$ 7.2
Children (n=152)	M (n=85)	Yoga	R	40.5 $\pm$ 7.9	38.2 $\pm$ 7.9	34.6 $\pm$ 8.4	50.8 $\pm$ 11	43.7 $\pm$ 9.2	39.2 $\pm$ 9.8
			L	40.7 $\pm$ 9.4	34.1 $\pm$ 8.0	30.2 $\pm$ 7.1	46.5 $\pm$ 9.4	38.9 $\pm$ 8.1	35.2 $\pm$ 8.9
	F (n=67)	Yoga	R	37.8 $\pm$ 10.1	35.5 $\pm$ 8.9	31.3 $\pm$ 9.1	49.2 $\pm$ 9.5	44.5 $\pm$ 9.5	38.2 $\pm$ 11.2
			L	37.3 $\pm$ 8.2	31.7 $\pm$ 7.1	27.4 $\pm$ 6.4	44.9 $\pm$ 9.9	38.3 $\pm$ 10.2	33.1 $\pm$ 8.4

TABLE II : Comparisons of (1) initial and final values of tapping speeds in 0–10 seconds (TS1) 10–20 seconds (TS2) and in 20–30 seconds (TS3) and (2) TS3 versus respective TS1 for initial and Final assessments.

Subjects	Sex	Category	Hand	Initial versus Final			TS3 versus respective TS1	
				TS1 %change	TS2 %change	TS3 %change	Initial %change	Final %change
Adults (n=53)	M n=43	Yoga	R	+18.7***	+12.5**	+10.7**	-10.6*	-4.2
			L	+17.4**	+16.0**	+14.6**	-14.4**	-12.3*
	F n=10	Yoga	R	+38.9**	+34.4**	+35.7**	-15.6	-17.5*
			L	+33.9**	+20.9**	+30.3*	-23.0*	-25.1***
Adults (n=38)	M n=21	Control	R	+4.1	+3.3	-0.2	-8.3*	-12.6*
			L	+4.5	+3.5	-6.3	-19.9	-28.3***
	F n=17	Control	R	-0.3	-1.6	-5.2	-16.4*	-20.6*
			L	+0.5	-0.1	-15.1	-12.8	-26.4**
Children (n=152)	M n=85	Yoga	R	+25.7***	+14.5***	+13.1**	-14.4***	-22.9***
			L	+14.1***	+14.3***	+16.3***	-25.8***	-24.3***
	F n=67	Yoga	R	+13.2***	+25.1***	+21.8***	-17.0***	-22.3***
			L	+20.2***	+20.6***	+20.6***	-26.0***	-26.2***

\*P<0.05, \*\*P<0.01, \*\*\*P<0.001 (Student's t-test).

#### Comparison of tapping speed between 20–30 seconds (TS3) and 0–10 seconds (TS1) :

At the initial assessment adults of the yoga group showed a significantly lower TS3 than TS1 of the left hand. After 30 days of yoga this difference was further enhanced (see Table II) and was also seen for the right hand TS (TS3 versus TS1). Adults of the control group showed a significantly lower TS3 than TS1 for the right hand initially, and for both hands at final assessment. Children showed significantly lower TS3 than TS1 for both hands at initial as well as final assessments (see Table II).

#### Motor Speed Asymmetry (MSA) :

MSA was calculated based on a formula (5),  $MSA = \{[\text{Right hand speed} - \text{Left hand speed}] / \text{Right hand speed}\} \times 100$ . For males of the yoga group MSA values at initial and final assessments were 10.9 and 9.3.

Females of the yoga group had initial MSA of 6.6 and final of 12.1. Males of the control group had MSA initial of 6.6 and final of 8.9. Females of the control group had 10.8 (initial) and 11.9 (final). For children the MSA values were 7.5 (initial) and 10.7 (final). A MSA value of 10 is expected in right-handed individuals, with values of 20 or more suggesting a greater than normal right hand advantage (6). Since all values were less than 20, they were within the expected range for right hand dominant persons.

#### DISCUSSION

There was a significant increase in baseline tapping speed (TS) between 0–10 seconds (TS1) 10–20 seconds (TS2) and 20–30 seconds (TS3) in both adults and children after 30 and 10 days of yoga respectively. However when TS between 20–30 seconds (TS3) and 0–10 seconds (TS1)

was compared, all subjects of yoga and control groups showed a significant decrease in TS3 versus TS1, initially and finally. There is no clear pattern of change in motor speed asymmetry (MSA), hence the data were not analysed further. The increase in baseline TS1, TS2 and TS3, following yoga may be attributed to better motor co-ordination (7) either associated with, or independent of improved muscular efficiency following yoga (8). The absence of change in the control group helps to rule out a retest, or practice effect. There was no control group for the children who received yoga training, hence the retest effect was not ruled out.

At each trial, as subjects continued the task for 3 contiguous 10-seconds periods, the TS3 significantly reduced, suggesting a fatigue effect. Hence for this repetitive and continuous task, yoga practice did not reduce fatigue. This may also be related to the fact that in the first 10 seconds, after

yoga training, subjects were significantly faster than in the first 10 seconds period before learning yoga. It is well known that an initial spurt of speed is difficult to sustain and results in fatigue. Strength typically refers to the capacity of the muscles to exert force under static conditions, though it can be measured under dynamic conditions, also. It was found that slower movements usually result in higher levels of measured strength (9). Also in case of repetitive dynamic work, the combination of force and frequency of repetition determines the length of time that the activity can be endured. The present results suggest that in adults and children of both sexes, yoga practice for 30 and 10 days respectively, increases the initial speed of tapping, which does not persist during the last 20-seconds of a 30-second test. It is also interesting to understand whether this result is restricted to speed of finger movements, or if it affects gross activities which require repetitive responses, such as swimming and bicycling.

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