

Effect of Yoga Program on Psychomotor Performance of Orphan Adolescents

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Abstract: *Psychomotor performance is an individual's ability to coordinate timely and to respond appropriately to stimuli. Studies have shown there is reduced psychomotor performance in children with early life stress, poverty and raised in institutions. The aim of the study was to evaluate the effect of yoga program on the psychomotor performance of orphan adolescents. Seventy two apparently healthy orphan adolescents participated in the study. They were randomized (based on their age and gender) and allocated into two groups as Yoga Group (YG) (n=40; 14 girls) aged 12.69 ± 1.35 (Mean \pm SD) years and Wait List Control (WLC) (n=32, 13 girls) aged 12.58 ± 1.52 (Mean \pm SD) years. YG underwent three months of yoga program with a schedule of 90 minutes per day, four days per week. The WLC group underwent the routine activity. Psychomotor tests assessed were Six Letter Cancellation test (SLCT) and Digit Letter Cancellation Test (DLST) in all the participants at the beginning and end of the program. Result showed significant improvement ($p < 0.001$) in the total and net scores of SLCT only in yoga group, whereas DLST improved significantly both in yoga ($p < 0.001$) and WLC ($p < 0.05$) groups. Three months yoga program was found useful for the young orphan adolescents in improving their psychomotor performance.*

Key words: *yoga, orphan, adolescent, psychomotor performance*

Introduction

Orphans are the disadvantage group who face many problems as poverty, grief, drug abused, neglected and exploited (Nayak, 2014). Prevalence of orphans is 143 millions worldwide (UNICEF, UNAID, & USAID, 2004) and 72 millions in south & eastern Asia (UNICEF, 2008) and 20 million in India alone (James & Rajan, 2008). Prior studies have shown that stressful experiences in childhood have a negative effect on latter life cognitive performance (Ritchie et al., 2011). Further study reveal that duration spend in orphan institution directly associated with more atypical sensory discrimination, praxis, and sensory modulation (Lin, Cermak,

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Coster, & Miller, 2005). It is reported that even low or moderate levels of stress can interfere with task performance (Motowidlo, Packard, & Manning, 1986) and Post Institutional children have shown attention deficits and hyperactivity symptoms (Kreppner, O'Connor, & Rutter, 2001; Stevens et al., 2008) and also reduced performance in various cognitive function domains (Bauer, Hanson, Pierson, Davidson, & Pollak, 2009; Bos, Fox, Zeanah, & Nelson III, 2009; Bruce, Tarullo, & Gunnar, 2009; Colvert et al., 2008; Pollak et al., 2010)

Psychomotor function refers to an individual's ability to coordinate timely and appropriate responses to stimuli. It is a complex phenomenon resulting from co-ordination of sensory and motor systems through integrative and organizational processes of the central nervous system and this can be assessed by using paper pencil test as Six Letter Cancellation Test (SLCT) and Digit and Letter Substitution Test (DLST) (Natu & Agarwal, 1997). The cancellation task involves visual scanning, activation, inhibition of rapid responses with sustained attention and concentration (Lezak, 2004) and the substitution task is used to assess visual scanning, mental flexibility, attention, speed of information processing, and motor speed (Lezak, Howieson, Loring, Hannay, & Fischer, 1995).

A study on performance of participants on mirror-tracing task found that yoga group had improved reversal ability, eye-hand co-ordination, speed and accuracy which were necessary for mirror star tracing (Telles et al., 1993; Telles, Raghuraj, Ghosh, & Nagendra, 2006). Different yoga techniques showed immediately after single session had positive improvement on test scored psychomotor test (Pradhan & Nagendra, 2010; Sarang & Telles, 2007). However, most of these studies reported an immediate effect of yoga on psychomotor functions and no study specifically on psychomotor performance of orphan children. Therefore this study aimed to evaluate effect of yoga for three months with an RCT on adolescents dwelling in an orphanage.

Methods

Participants: 80 apparently healthy orphans of any type, aged between 11 to 16 years of both the genders were chosen for the study from an orphanage in a suburban area of Bangalore. The study was conducted between 1st September 2014 and 30th November 2014.

Ethical clearance: Ethical clearance has been approved by the Institutional Ethics Committee of SVYASA (Swami Vivekananda Yoga Anusandhana Samsthana) University in accordance with Helsinki declaration of 1978. Signed informed consent from the institution head and a signed informed assent from all participants were also obtained, upon explaining the study details.

Design: The study was a randomized wait list control pre-post study. After the initial process of screening, participants were randomized by a statistician using a computer random number table from *www.randomizer.org* and assigned into two groups: yoga group (YG) and wait list control (WLC) group. The YG underwent the yoga program for 3-months where as in the WLC group underwent day to day regular activities.

Blinding: Blinding of the statistician who generated the randomization sequence and subsequently analyzed the data, and the researchers who carried out the allocation & assessments, were only possible.

Intervention: The YG received a combined approach of yoga activities of 90 minutes, 4 days/week, for 3-months. The yoga program was supervised by two certified yoga teachers from SVYASA. The principle and concept of an integrated approach of the yoga program was based on the research work of SVYASA (Nagarathna & Nagendra, 2006). The yoga program includes basic concepts of yoga and instructions for 10 minutes; warm ups, loosening and stretching for 10 mins; *suryanamaskar* 10 to 12 rounds for 10 minutes; yoga postures (*asanas*) which includes standing, sitting, prone and supine types for 20 minutes; voluntary regulated breathing (*pranayama*) for 15 minutes, deep relaxation technique (DRT) for 10 minutes for every class and concentration techniques (*trataka*) for 15 minutes or yogic games 15 minutes (in alternate sessions).

Assessments: The following two psychomotor tasks were modified version for Indian population (Natu & Agarwal, 1997). Data were collected by the research staff of SVYASA at the beginning and after the intervention period for all recruited participants.

a) The Six Letter Cancellation Task (SLCT) (Natu & Agarwal, 1997) is a worksheet with six specified target letters, which are to be cancelled and have a working section consisting of alphabets arranged randomly in 22 rows and 14 columns. Participants were asked to cancel the target letters as much as possible in 90 sec with any possible strategy. The total number of cancelled letters, wrong targets and net scores (total attempted-wrongly attempted) were calculated for analysis.

b) Digit Letter Substitution Test (DLST) (Natu & Agarwal, 1997): The digit-letter substitution task measures psychomotor performance (Gerrard, Wheeldon, & McDevitt, 1995), which is based on earlier developed substitution tests (e.g., the Digit Symbol Substitution Test) where letters are used instead of the symbols in other substitution tasks (Van der Elst, van Boxtel, van Breukelen, & Jolles, 2006). It is a worksheet with a specified row of six different digits matched with six different letters with pairs, which were to be cancelled and had a working section

consisting of different pairs arranged randomly in 22 rows and 14 columns. Participants were asked to cancel the correct pairs as much as possible in 90 sec with any possible strategy. The total number of cancelled pairs, wrong targets and net scores (=total attempted-wrongly attempted) were calculated for the analysis.

Analysis: Data were analyzed using the Statistical Package for Social Science (Version 18.0). Categorical variable, gender were analyzed using Chi square test. The Independent 't' test was used to check the difference between the groups. Analysis of repeated measures ANOVA followed by Bonferroni post-hoc was performed to check the pre post differences of both psychomotor outcome measures.

Results

There were no dropouts from YG and eight from WLC. Out of the eight, two were sick, two were suspended during the post assessment due to their behavioral issues and other four did not complete the task. Data of 40 YG and 32 WLC participants were available for final analysis. The baseline mean age between groups was matched ($p=0.78$, Independent 't' test). The distribution of gender ($p=0.624$, χ^2 test) was not significantly different between the two groups.

Repeated measures ANOVA showed that there were no significant differences between the mean score of two groups at baseline ($p>0.05$) for both the psychomotor tests. There were significant difference found in times (pre-post) score for SLCT-T $F(1,70)=8.125$, $p=.006$, SLCT-N $F(1,70)=8.177$, $p=.006$; DLST-T $F(1,70)=24.843$, $p<0.001$, DLST_N $F(1,70)=26.056$, $p<0.001$; whereas there were no significant difference SLCT-W $F(1,70)=0.245$, $p=.622$, DLST_W $F(1,70)=1.997$, $p=.162$ (Table 1).

The group by time interaction showed significant differences ($p < 0.05$) in SLCT-T, SLCT-N; whereas there were no significant in difference SLCT-W, DLST-T, DLST_W, DLST_N.

The post-hoc test with Bonferroni adjustment within YG showed significant improvements ($p<0.001$) in score for, SLCT-T (22.44 %), SLCT-N (22.37 %), DLST-T (19.78 %), DLST_N (21.03 %), whereas there were no significant improvement in SLCT-W (26.32 %), DLST_W(66.67 %). But, within WLC group, showed a significant improvement in DLST-T (10.16 %), DLST_N (10.56%), whereas there were no significant improvement in SLCT-T (2.69 %), SLCT- W (27.27 %), SLCT-N (2.39 %), DLST_W(57.14 %) (Table 1).

Table 1. Comparison of the Psychomotor tasks of Yoga and Wait-List Control group

	YOGA (n = 40)			
	PRE		POST	
	Mean ± SD	95% C.I. (LB to UB)	Mean ± SD	95% C.I. (LB to UB)
SLCT_T	26.40 ±8.91	23.44 to 29.36	32.33 ± 10.08***	29.34 to 35.31
SLCT_W	0.48 ± 1.34	0.14 to 0.81	0.60 ± 1.92	0.11 to 1.09
SLCT_N	25.93 ± 8.78	23.01 to 28.84	31.73 ± 9.82***	28.80 to 34.65
DLST_T	34.88 ± 8.61	31.77 to 37.98	41.78 ± 9.33***	38.50 to 45.05
DLST_W	0.53 ± 2.03	0.04 to 1.01	0.18 ± 0.50	0.04 to 0.31
DLST_N	34.35 ± 9.18	31.17 to 37.53	41.58 ± 9.52***	38.26 to 44.89

	WLC (n = 32)				Group* time interactio
	PRE		POST		
	Mean ± SD	95% C.I. (LB to UB)	Mean ± SD	95% C.I. (LB to UB)	
SLCT_T	29.06 ± 9.92	25.76 to 32.37	29.84 ± 8.65	26.50 to 33.18	.032
SLCT_W	0.34 ± 0.60	-0.04 to 0.72	0.44 ± 0.95	-0.11 to 0.99	.944
SLCT_N	28.72 ± 9.80	25.46 to 31.98	29.41 ± 8.52	26.14 to 32.67	.027
DLST_T	36.91 ± 11.23	33.43 to 40.38	40.66 ± 11.56*	37.00 to 44.31	.145
DLST_W	0.22 ± 0.49	-0.33 to 0.76	0.09 ± 0.30	-0.06 to 0.24	.505
DLST_N	36.69 ± 11.15	33.13 to 40.25	40.56 ± 11.62**	36.86 to 44.27	.128

Legends: SLCT_T (Six Letter Cancellation Task Total Score), SLCT_W (Six Letter Cancellation Task Wrong Score), SLCT_N (Six Letter Cancellation Task Net Score; DLST_T (Digit Letter Substitution Task Total Score), DLST_W (Digit Letter Substitution Wrong Score), DLST_N (Digit Letter Substitution Net Score).

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; pre compared with post.

Discussion

The present study intended to study the effect of three months of on the psychomotor functions of orphan adolescents in comparison with yoga and WLC group. The results showed that both the groups have improved in the net and total scores of DLST, but the magnitude of change is higher in YG as compared to WLC. In contrast, no change was observed in control group in SLCT and YG showed statically significant improvement as compared with the baseline scores. The group by time interaction showed significant differences ($p < 0.05$) in SLCT-T, SLCT-N. This suggests performance of the YG is better than WLC.

Earlier findings were consistent with present study on SLCT (Pradhan & Nagendra, 2010, Bhuyan & Mishra, 2013); DLST (Javadekar & Manjunath, 2012; Pradhan & Nagendra, 2010) irrespective of difference in designs, duration of interventions, components of yoga, magnitude of change and samples included.

The improvement in performance of psychomotor tasks in this study might be due to enhancement in internal awareness (Javadekar & Manjunath, 2012), selective attention (Sarang & Telles, 2007), and cortical inhibition (Subramanya & Telles, 2009) because of integrated yoga techniques including yoga postures, relaxation, Suryanamakar with rhythmic breathing. Yoga breathing techniques (*Pranayama*) had influence on pre-frontal cortex (Bhargav, Nagendra, Gangadhar, & Nagarathna, 2014) which is associated with memory, attention, and executive functions (Gray, Braver, & Raichle, 2002; West, 1996). It may regulate the autonomic functions by dominating sympathetic (Raghuraj, Ramakrishnan, Nagendra, & Telles, 1998; Telles, Singh, & Balkrishna, 2011; Veerabhadrapa et al., 2011) or parasympathetic tone (Pramanik, Pudasaini, & Prajapati, 2010; Raghuraj & Telles, 2008) which could be the reason for reduction of anxiety and chronic stress levels and cause for improvement of attention. Yoga-based guided relaxation and meditation has also been reported to reduce sympathetic activity, balance neuro-endocrine path and decrease anxiety and stress levels (Lee et al., 2007; Vempati & Telles, 2002) could have facilitated increase attention task performance. Yogic games are a set of games which may have played an important role in process of stimulation and relaxation by calming down the mind (Nagendra & Nagarathna, 2007).

The strengths of the study were the randomized control design with good sample size. This study was conducted on adolescents belonging to one orphanage only which can be considered as a limitation. Multi-institutional studies can be conducted in future with orphans belonging to different age groups stratified on the basis of severity of early life stress. The current study on the effect of the yogic intervention provides evidence in improving psychomotor performance of the orphans which may help them to gain their academic excellence. Intervention of yoga over a three-month period showed significant improvements on psychomotor performance in the orphan participants.

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