



REVIEW ARTICLE

EVALUATING THE EFFECTIVENESS OF NEUROLINGUISTIC PROGRAMMING AND STRUCTURED EXERCISES ON MOTOR SKILLS, PHYSICAL FITNESS AND ATTENTION IN AN ADHD CHILD – A CASE STUDY

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ABSTRACT

**Background and Purpose:** Attention Deficit Hyperactive Disorder (ADHD), is a prevalent, highly impairing neuro developmental disorder defined by developmentally inappropriate symptoms of inattention, impulsiveness and overactivity. In India the prevalence of ADHD is reported to be increasing, furthermore a pilot study revealed that the motor skill and Physical fitness of ADHD children are found to be reduced compared to the typically developing children. The purpose of this case study is to find the effectiveness of Neurolinguistic Programming and Structured exercises on motor skill, physical fitness and attention in a ADHD child.

**Case description:** A 9 years old boy, who was diagnosed with ADHD, received Neurolinguistic Programming once in a week for 6 weeks along with Structured exercise Program for 3 times/ week for 6 weeks period. Each session was given for 45 minutes.

**Outcome:** Motor skills, physical fitness and attention was measured using a battery of test: (1) muscle strength, muscle endurance, Sit and reach test, Vertical jump test, 12 Minute walk/run test, Step test, Single leg triple hop test, Ball throw test, Nine hole peg test, Trail making test.

**Conclusion:** This case study concludes that the 6-week combination of structured exercises and Neurolinguistic Programming had a positive effect on the gross motor skill, Fine motor skill, overall fitness level, and attention of a child with ADHD.

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INTRODUCTION

Attention Deficit Hyperactive Disorder (ADHD), is a prevalent, highly impairing neuro developmental disorder defined by developmentally inappropriate symptoms of inattention, impulsiveness and overactivity. It is considered as predominantly a childhood disorder but continues to manifest itself through adolescence and adulthood. Worldwide the prevalence of ADHD has been documented at 5.3% to 20% (Moffitt and Melchior, 2007; Polanczyk et al., 2007), while in India studies based on hospital or outpatient clinic populations with some degree of referral bias have reported a prevalence of 5.2% to 29.5% (Bhatia et al., 1991; Mukhopadhyay et al., 2003; Kaur et al., 2006). The diagnostic and statistical manual of mental disorder-DSM-V (APA, 2013) groups behavioral symptoms into two lists, representing clusters of inattention

(e.g., often has difficulty sustaining attention in tasks or play activities) and hyperactivity-impulsivity (e.g., is often "on the go" or often acts as if "driven by a motor"). A child with ADHD must demonstrate six of nine symptoms for a diagnosis of the inattentive subtype, six of nine symptoms for a diagnosis of the hyperactive-impulsive subtype, or six symptoms from both inattention and hyperactivity-impulsivity for the combined subtype (APA, 2013). ADHD children have significant problems in executive function such as controlling impulsive behaviour, cognition and attention. In addition ADHD children show difficulties with motor coordination and control, and often have difficulty with performing a number of tasks that involve motor skills. Motor skill development is a critical dimension of the overall development of the young child and it is important to assess the present level of motor skill abilities of the child, particularly the child with ADHD to monitor the growth and development of the child. Motor skill levels and physical fitness have been found to be interrelated (Scott et al., 2007). Physical fitness is considered to be a powerful marker of generalized health outcomes in children

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and adolescents. Studies of the relationship between physical fitness and overweight or obesity in young people have indicated that there is an inverse relationship between the two factors (Bovet *et al.*, 2007). A low level of fitness has also been associated with diabetes as well as cardiovascular disease. A pilot study revealed that children with ADHD are less fit than their peers (Jeyanthi *et al.*, 2016) predisposing them to a greater extent to disease and health issues in their adult life. It is thus imperative that physical fitness specifically tested and addressed in a structured manner in children with ADHD.

The development of motor skills and fitness is associated with cognitive development. Recently, the impacts of exercise on children's cognitive process have been assessed in cross-sectional studies which found that a higher level of aerobic fitness was associated with better interference control, a component of the executive control, in a task performance (Stroop Task) in children without disabilities (Buck *et al.*, 2007). These authors had already shown that a high level of fitness was associated with parameters of attention, working memory, and speed response in children (Hillman *et al.*, 2005). There is growing body of researches observed lower cardiorespiratory fitness relates to an increased occurrence of failures in sustained attention (Chaddock *et al.*, 2011). The mechanisms underlying fitness-related deficits in sustained attention likely relate to differences in brain structure and function. Specifically, findings from cross-sectional investigations of aerobic fitness in preadolescent children have observed modulations in neuroelectric indices of cognition, with lower aerobic fitness being associated with deficits in response inhibition, reductions in the allocation of attentional resources, delays in the speed of information processing, and decreased integrity of action-monitoring processes (Hillman *et al.*, 2005; 2009; Pontifex *et al.*, 2011). Accordingly, poorer aerobic fitness may be associated with inefficient neural resource allocation resulting in more frequent and longer lapses of sustained attention. Beyond functional deficits, deficits in neural structures in the basal ganglia and hippocampus have also been observed in lower-fit children compared to higher-fit children along with poorer performance on inhibitory control and relational memory tasks, respectively (Chaddock *et al.*, 2010a; 2010b).

The recommended management of ADHD typically involves Pharmacologic treatments in combination with behavioral treatment (Taylor *et al.*, 2004). Pharmacologic treatments, including stimulant and non-stimulant medications. Behavioral treatment which mainly comprise counselling, parent management training, social skill training, neurofeedback, and school-based contingency management. Despite the fact that this multimodal approach has been shown to be effective in reducing ADHD symptoms (MTA Cooperative Group, 1999; Oord *et al.*, 2008), it seems that these effects cannot be sustained beyond 24 months (Jensen *et al.*, 2007). Furthermore in regard to stimulant medication, some children experience serious side effects (Graham and Coghill, 2008) and there is growing concern among parents about the unknown long term effects (Berger *et al.*, 2008). These limitations have led to a growing demand for alternative non-pharmacological interventions for children with ADHD. Motor skills difficulties have been related to limited participation in physical activity (Bouffard *et al.*, 1996). Thus, improvement in motor skills could be an important variable facilitating the sport participation for ADHD children. Many researchers had

supported the increase in physical activity, increases cognitive domain (Verret *et al.*, 2010). Buck *et al.*, (2007) suggest that their findings add support to the beneficial effects of physical activity, or fitness level, on cognitive performance during development in preadolescent children. Healthcare professionals have more or less ignored the impact of the disorder and/or the effects of inactivity on fitness and their ability to perform skilled movements. Furthermore, despite increasing evidence that suggests the importance and benefits of exercises there is no structured protocol that has been established to treat these children. Thus, the overall aim of this case study is to establish a comprehensive, structured interventional protocol that includes a combination of exercises and behavioral therapy (Neurolinguistics programming) to address these deficits. Importantly, the interventional protocol should be school-based so that it can be implemented and integrated within the school physical education curriculum and thus, allow ADHD children to participate in it without prejudice and consequently improve peer acceptance.

## Case Description

### Patient history and System review

The subject of this case study was a 9 years old boy (studying in fourth class) who had been diagnosed as ADHD one year back by the Clinical Psychologist further confirmed by Paediatrician. The child according to parent always restless, bumps into things, unable to concentrate in any activities for long period of time, gets tired easily and had lower performance academically. According to the teacher the child was disobedient, had reduced attention span, doesnot liked by Peers, impulsive in nature, had frequent falls/bumps into things and performs poorly in academics. The child was initially screened by Physiotherapist during the Physical fitness testing at his school and further referred to Physiotherapy department of Amar Jyoti Institute of Physiotherapy. The informed consent was taken from the Parent and assent form was obtained from the Child, then the case study was performed.

**Examination:** The subject was of height 1.38 m; weight 28.4 kg Body Mass Index of 14.9. Motor skills, physical fitness and attention was measured using a battery of test. In gross motor skill, the locomotor skill was assessed by Single leg triple hop test where the subject stands behind the start line & hops nonstop with single leg consecutively for three times. The distance was measured and it was 1.23 m and 1.11 meter using right and left leg respectively. In gross motor skill testing the object control skill was tested using ball throw test, where the subject sits in the centre of the circle assuming straddle sitting position (Leg extended and 24 inch apart) holding the 2 kg medicine ball by both the hands and taken it behind and over head by flexing elbows. With simultaneous extension of elbows and forward swing of upper body the ball was thrown in forward direction as far as possible. The distance from centre of circle to the ball lands first was measured and it was 0.98 meters. The fine motor skill was assessed by Nine hole peg test, the time taken to complete the task with right hand was 50.08 seconds and left hand was 60.47 seconds. The physical fitness of the subject was tested for the components such as muscle strength, muscle endurance, flexibility, aerobic and anaerobic capacity. The muscle strength was measured through hand grip strength it was 19.8 pounds and 15.4 pounds for right and left hand respectively. The muscle endurance was

measured using 1 minute curl up test where the subject was able to perform for four times. The flexibility was measured by sit and reach test it was found to be 15.24 cm. The leg explosive power which was measured with vertical jump distance and it was 12 cm. The aerobic capacity was determined by cooper 12 minutes walk/run test the subject covered a distance of 1.2 km, hence the predicted  $VO_2$  Max is 15.54 ml/min/kg. The anaerobic test was measured by Step test 37.03. The attention was measured by trail making test children version the time taken to complete the form A and B was 149 and 164 seconds respectively. Part A was completed without errors whereas Part B was completed with three sequence errors and two omission errors.

### Treatment

After the baseline assessment the subject was treated with structured exercises and Neuro Linguistics Programming. The structured exercises comprises of gross motor training for 21 minutes which includes resistance exercises such as abdominal curl ups, back extensor strengthening and aerobic exercises such as hopping, rope jumping, Stepping. Fine motor training for 4 minutes, attention training for 10 minutes. The treatment was given 3 days per week for 6 weeks. Neuro linguistic programming (NLP) is an emerging behavioural treatment, which was administered once a week for 6 weeks period. NLP increases self awareness and uses a form of communication frame work as along with vision, auditory and kinesthetic senses to modify behavior. NLP Reframing technique was used for this subject. Reframing technique is a six step technique in which hyperactive/impulsive behavior was reframed to positive behaviour. Each sessions lasted for 45 minutes.

### Outcomes

The subject was reevaluated after 6 weeks of treatment. The gross motor skill was found to be improved in locomotor skill from 1.23 and 1.11 meter to 1.91 and 1.35 meter using right and left leg respectively. There was no improvement found in object control skill. However the fine motor skill showed significant improvement, the time taken to complete the task was found to be reduced from 50.08 and 60.47 seconds to 38.33 and 48.5 seconds with right and left hand respectively. The muscle endurance which is assessed through 1 minute curl up test improved from 4 to 12. The flexibility improved from 15.24 cm to 19.05 cm. The explosive power of leg improved from 12 cm to 18.5 cm. In cooper 12 minute walk/run test the distance covered increased from 1.2 km to 1.43 km hence the predicted  $VO_2$  Max increased from 15.54 to 20.68 ml/min/kg. The anaerobic capacity improved from 29.63 to 37.03 Watts. However the muscle strength was found to remain unchanged. The attention test showed the improvement in the time taken to complete Part A from 149 to 94 seconds; Part B from 164 to 121 seconds in Part B no omission errors were found the sequence error reduced from three to two.

### DISCUSSION

The result of this case study shows the combination of structured exercises and Neurolinguistic programming significantly improved the gross motor skill, fine motor skill, physical fitness and attention of ADHD child. The whole gained results can be treated under the framework of the dynamic systems theory. According to the dynamic systems

theory, the environment is an important factor for growth of the motor skills. The theory poses that the factors which affect the motor growth including the motor task interact with individual (biologic and heritage factors) and the environment (experience and learning factors) and such factors are effective in growth of strong, displacement motor skills, gross and fine motor skills and manipulative motor skills. Thus this study created an atmosphere to promote physical exercises, hence the model of treatment found to be effective in treatment of ADHD. Taylor and Kuo (2009) reported that exercise helps to heighten the response to stressors, that is, the students became less stressed to the same stressors when in a fit condition. The researchers also mentioned that, mood is made better by raising the levels of neurotransmitters that works as antidepressants (dopamine, nor-epinephrine, and serotonin). All of these neurotransmitters were increased by exercises. Exercise reenergizes depressed brains to do its job of adapting to environment.

The results of this case study is in agreement with the findings of Maddigan *et al.*, (2003), who concluded that exercises would be effective in reducing symptoms or medication dose in attention deficit hyperactivity disorder in school age subjects who were already stabilized on medication. The improvement in inattentiveness was also supported by Went (2000) who stated that there was positive shift observed in concentration among subjects with ADHD after they participated in therapeutic movement therapy. The results showed positive improvements on working speed, social and behavioral problems. Thus results in this particular case were found to be favourable interms of motor skill, Physical fitness and attention in ADHD child. In future, Randomized Controlled Trial can be conducted to generalize the effectiveness of this treatment. Research on follow up of this case can also be done to find the long term effectiveness of the treatment.

### Conclusion

In conclusion, the 6-week combination of structured exercises and Neurolinguistic Programming had a positive effect on the gross motor skill, Fine motor skill, overall fitness level, and attention of a child with ADHD.

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