

CLINICAL STUDY

Does acupuncture have a positive effect on school success in children?

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Abstract

OBJECTIVE: To evaluate school success in pediatric patients undergoing acupuncture treatment for various indications.

METHODS: The grades achieved during both school terms by children undergoing acupuncture treatment for various indications at the pediatric outpatient clinic of Ulus State Hospital were analyzed. Exam grades in mathematics, social studies, and Turkish was compared between the first and the second terms. Forty children were included in the study, with 22 male and 18 female, and their average age was 11.1 years. These patients were undergoing acupuncture treatment for attention deficit-hyperactivity disorder (ADHD), enuresis nocturna, migraine, obesity, atopic dermatitis, alopecia areata, and Tourette's syndrome. Treatments were done at the beginning of the second term. Four of the 25 patients with ADHD had borderline intelligence quotients. The report cards of all 40 patients were examined, and their grades in the first and the second school term were compared.

RESULTS: There was a statistically significant increase in the grades obtained in mathematics, social studies, and Turkish ($P < 0.005$) by the students from the first to the second school term. When 4 ADHD patients with borderline deficiency in intelligence were excluded, and the grades among the 21 patients with ADHD were compared for both terms, there was also a statistically significant increase in mathematics, social studies, and Turkish grades ($P < 0.05$).

CONCLUSION: Acupuncture contributed to the academic success of the children who underwent acupuncture treatment for their primary symptoms.

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Key words: Acupuncture; Child; Learning; Attention deficit disorder with hyperactivity

INTRODUCTION

Acupuncture is known to be effective for the treatment of numerous diseases and has been used in Asia for thousands of years. The effectiveness of acupuncture is explained in terms of concepts such as *Qi*, *Yin*, and *Yang* in Traditional Chinese Medicine.¹

From the perspective of biomedicine, acupuncture stimulation is known to cause secretion of opioid-like substances, affect the sympathetic and parasympathetic nervous systems, increase local blood flow, increase nitric oxide production, and influence many other mediators and hormones.²⁻⁴

Acupuncture is a widely used method of treatment for children as well as adults. According to a study analyzing complementary and alternative medicine methods used in children, acupuncture is the second most stud-

ied method (32%).⁵ Clinical studies have shown that acupuncture may be used in pediatric patients for indications such as pain, nausea and vomiting, seasonal allergic rhinitis, neurologic disorders and gastrointestinal disorders and is an effective and safe method.⁶

The effects of acupuncture on learning and success levels in children have not been well studied. According to a functional MRI study in adults, an increase in brain activity in the temporal and frontal lobes of the brain is related to memory and perception after acupuncture administration among patients with moderate perception disorder.⁷

The aim of the present retrospective study was to examine the effects of acupuncture on school success in 40 pediatric patients undergoing acupuncture treatment for various indications.

MATERIALS AND METHODS

Subjects and treatments

Forty patients who were admitted to the Ankara Ulus State Hospital pediatric out-patients clinic between March 2012 and May 2012 were included in the study. This study was conducted with approval from the Ankara Education and Research Hospital ethics committee (11.07.2011/3914) and written informed consent was provided by the parents of all subjects. Ten sessions of acupuncture in total, twice a week for the first 2 weeks and once a week later, were administered in all subjects. Each session lasted for 20 min. Electroacupuncture was not used. Needles were manipulated manually to induce the "de Qi" (arrival of Qi) sensation by lifting, thrusting, and twirling. Disposable, sterilized steel needles were used for acupuncture. A needle size of 0.20 mm × 13 mm or 0.25 mm × 25 mm was chosen according to the child's age and weight.

Common points used in the treatment of all patients were the Baihui (GV 20), Hegu (LI 4), Zusanli (ST 36) and Neiguan (PC 6) while Baihui (GV 20), Hegu (LI 4), Shenmen (HT 7), Neiguan (PC 6), Zusanli (ST 36), Taichong (LV 3) and Yintang (EX-HN 3) points were chosen for attention deficit-hyperactivity disorder (ADHD). Acupuncture points suggested by Chinese medicine according to the presenting symptoms were used for the other patients.

The grades in math, social studies, and Turkish shown on the report cards of the patients before acupuncture treatment and after 10 weeks of treatment were com-

pared. The report cards were obtained from the children's parents.

Statistical analysis

The data were analyzed using SPSS for Windows 11.5 software package (SPSS Inc., Chicago, IL, USA). Normality was evaluated using the Shapiro Wilk test. Definitive statistics are reported as the mean ± standard deviation for discrete numerical values and as the number and percentage of cases for nominal variables. Statistically significant changes in average grades between the first and the second term were evaluated using the dependent Student's *t*-test. Results were accepted as statistically significant with a *P* < 0.05.

RESULTS

A total of 40 pediatric patients were included in the study (22 male and 18 female), and they ranged in age from 7-16 years [mean age, (11.1 ± 2.7) years]. The patients underwent acupuncture treatment for ADHD (25 cases), enuresis nocturna (8 cases), migraine (2 cases), obesity (2 cases), atopic dermatitis (1 case), alopecia areata (1 case), or Tourette's syndrome (1 case). All patients with ADHD included in the study were diagnosed by a child psychiatrist. None of the patients used medications during the 6 months prior to acupuncture treatment.

When the average grades of all cases in the first and second term were compared, significant increases in the grades obtained for all three courses were found (*P* < 0.05) (Table 1).

Four of the 25 patients admitted with ADHD were suspected to have mental developmental delays and were referred to a psychologist for an intelligence test. According to the results of the WISCAR test, all 4 of these patients had borderline intelligence quotients (IQs). A total of 36 pediatric patients were included [20 male and 16 female, (11.0 ± 2.7) years] after the 4 patients with borderline IQs were excluded. There was a statistically significant difference in average grades in all three courses for the first and the second term among the remaining 36 cases after these 4 patients were excluded (*P* < 0.05) (Table 2).

Twenty-one of the 40 patients [11 male and 10 female, (11.3 ± 2.8) years] had been treated for ADHD. There was a statistically significant increase in school success among patients with ADHD when their grades were compared (*P* < 0.05) (Table 3).

Table 1 Average grades in the first and second term of different courses in 40 cases ($\bar{x} \pm s$)

Lesson	Grade		<i>P</i> value	Amount of change
	First term	Second term		
Mathematics	66 ± 22	72 ± 22	0.002	6 ± 12
Social Studies	75 ± 16	78 ± 17	0.049	3 ± 9
Turkish language	70 ± 20	75 ± 18	0.007	4 ± 10

Table 2 Average grades in the first and second term of different courses in 36 cases ($\bar{x} \pm s$)

Lesson	Grade		P value	Amount of change
	First term	Second term		
Mathematics	67.3±22.5	74.5±20.5	<0.001	7.2±1.6
Social Studies	76.4±15.3	80.5±14.4	0.004	4.1±7.9
Turkish language	72.9±18.5	77.3±16.2	0.015	4.4±0.4

Table 3 Average grades in the first and second term of different courses in 21 patients treated for ADHD ($\bar{x} \pm s$)

Lesson	Grade		P value	Amount of change
	First term	Second term		
Mathematics	60.9±21.4	70.8±20.1	0.003	9.9±3.3
Social Studies	72.5±12.8	77.6±13.5	0.023	5.1±9.5
Turkish	67.8±16.9	74.0±16.4	0.027	6.2±2.0

Note: ADHD: attention deficit-hyperactivity disorder.

DISCUSSION

In this study, we determined that school success is positively affected in children undergoing acupuncture treatment for various indications. Most of our patients were diagnosed with ADHD and the major complaint from the families was poor school performance. Our study results are supported by the subjective observations of the parents, and we conclude that acupuncture treatment positively affected school success in these children.

ADHD is characterized by lack of attention (attention is easily distracted and cannot be maintained) and excessive motor activity and restlessness. It is the most common neurobehavioral disorder in childhood with an incidence of 7%-9%.⁸ Affected children have poor school performance and problems in their relations with members of their family and friends. Genetic and environmental factors play a role in the etiology of ADHD. Moreover, morphological and functional differences have been identified in the brains of these patients. These differences include decreased volumes of the corpus callosum, basal ganglia, frontal lobes, and hypoperfusion in the frontal striatal dopaminergic pathways.⁹

The most effective psychotropic medications for the treatment of ADHD are stimulants. The most commonly used stimulants are methylphenidate (MPH) and methylphenidate derivatives. These medications significantly reduce clinical symptoms but have minimal effects on poor school performance or anti-social behaviors.⁹

Patients with ADHD have defects in dopamine, norepinephrine, serotonin, and glutamate pathways. MPH alters serotonin levels by inhibiting the uptake of dopamine and norepinephrine, as demonstrated by increased levels of these neurotransmitters in the brain tissue of patients receiving MPH.^{10,11}

MPH causes side effects such as loss of appetite, insom-

nia, restlessness and weakness, and the effects of long-term use of MPH are uncertain. Therefore, many parents seek alternative methods of treatment.¹² Patients admitted to our outpatient clinic who had undergone prior medical treatment reported similar side effects, and many parents refused to use medications because of these side effects. Moreover, some studies suggest that superoxide production in the brain is increased with MPH treatment¹³⁻¹⁵ and neurodegenerative effects are associated with long term high-dose use.¹¹

We conducted this study after receiving reports from parents of children receiving acupuncture treatment that suggested a decrease in symptoms. The parents reported positive feedback from teachers regarding their children's improved performance in school. More than half of the cases included in the study had been diagnosed with ADHD, often because of poor school performance.

In our opinion, the increase in school success identified in this study is the result of the positive effects of acupuncture on learning and recollection. Various studies indicate that acupuncture positively effects memory and the ability to learn.

Although there are numerous neurotransmitters that may regulate these effects, dopamine plays the most important role because dopamine affects memory functions both directly and indirectly. Dopamine directly affects the prefrontal cortex, the hippocampus, and synaptic connections in the striatum, and it plays a major role in memory regulation.¹⁶ Indirectly, dopamine contributes to acetylcholine regulation and effects memory performance.¹⁷

Various studies demonstrate the effects of acupuncture on dopamine levels. A study by Chuang *et al.*¹⁸ using an experimental dementia model in rats induced by cerebral ischemia showed that acupuncture applied to the Baihui (GV 20) point causes an increase in dopamine levels in the cerebral cortex and the hippocam-

pus. Cerebral atrophy due to ischemia was also reduced in the acupuncture treatment group. Moreover, acupuncture contributed to the protection of dopaminergic neurons in rats with Parkinson's disease.¹⁹ As stated in these studies, acupuncture mimics the effects of stimulants in children with ADHD but without the side effects of stimulants.

Acupuncture has positive effects on the hippocampus and amygdala, two zones of the brain that are related to learning and memory. The hippocampus plays an important role in short term and three-dimensional memory.^{20,21} Acupuncture has a protective effect on these tissues. Electroacupuncture (EA) maintained the protection of the dorsal hippocampus and cognitive state in pilocarpin-induced epileptic rats with cognitive disruptions.²²

According to a study by Feng *et al.*,²³ acupuncture reduces cell destruction. Clinically, acupuncture improves perception quality by preventing the reduction of limbic structure volume.²² The serotonin pathway has a major role in this effect. Acupuncture may contribute to learning and perception by increasing serotonin levels. Dos Santos *et al.*²² used the Baihui (GV 20), Dazhui (GV 14), Yintang (EX-HN 3), Zusanli (ST 36), and Sanyinjiao (SP 6) points in their studies. We also used many of these points in our patients.

Neurotrophic substances may also contribute to the positive effects observed in our study, as acupuncture affects the expression of neurotrophic substances.²⁴⁻²⁶ In a study by Manni *et al.*²⁶ socially isolated rats with reduced learning capacities were divided into two groups, and EA-treated rats showed increased stress resistance, improved learning, and positively affected memory. Neurotrophic mediators — like nerve growth factor (NGF) and brain-derived neurotrophic factor (BDNF) — related to learning and memory regulation were increased in EA-treated rats compared with the control group.²⁶ NGF and BDNF are active in the limbic system and are effective in regulating stress-related behaviors and learning and memory performance.^{27,28}

Our patients subjectively reported spending more time studying after acupuncture treatment, more participation in class, and improved understanding of class material. These findings may be explained by the mechanisms discussed above.

Studies have shown that acupuncture points including Renzhong (GV 26), Shenmen (HT 7), Shenshu (BL 23) and Neiguan (PC 6) improve learning and memory.²⁹ The Neiguan (PC 6) point is frequently used for the treatment of nausea and vomiting and cardiac symptoms. Neiguan (PC 6) may have tranquilizing properties and is used in the treatment of psychosomatic diseases.^{30,31} Neiguan (PC 6) acupuncture in rats exposed to chronic stress causes anxiolytic effects and improves memory.^{29,32} Cholinergic neurons in the brain mediate this effect and these neurons affect learning and memory functions in both humans and animals.²⁹

When acupuncture is applied to the Neiguan (PC 6) point in stress-exposed rats, memory functions are protected and acetylcholine levels are increased in hippocampal zones CA1 and CA3.²⁹ In particular, cholinergic neurons in the hippocampal area are known to regulate short-term data retention and long-term use of memory.^{33,34} The Neiguan (PC 6) point, which is considered effective in the treatment of stress, was used in all study subjects. Using this point may have contributed to increased school performance.

As a result of acupuncture treatment, school performance was improved significantly in all 36 cases. In particular, school performance among patients with ADHD was greatly improved. In our opinion, this is because of an increased willingness to study and improved learning and recollection capacities. Acupuncture is a cheap and reliable treatment that can be applied as a primary treatment method in these patients for various symptoms, including lack of attention, reluctance to learn because of depression, school phobia, exam anxiety and other behavioral disorders caused by stress. This alternate treatment modality avoids medications and their various side effects.

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