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The Effect of Scalp Acupuncture on Autism: Could This Be a Possible Treatment of Autism?

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Abstract

No current conventional treatment methods have been proven effective in improving core symptoms of autism spectrum disorders (ASD). In pursuit of a potent remedy for ASD, scalp acupuncture, one of the complementary and alternative medicines (CAM), may have potential in treating children with ASD according to recent clinical studies. In our first study, the effect of scalp acupuncture on prominent symptoms of ASD was investigated. Factors contributing to the effectiveness of ASD such as age and onset pattern had also been evaluated. Results showed that verbal communication and social and behavioral aspects of the patient could benefit from scalp acupuncture. Moreover, early intervention before 3 years old will bring about better therapeutic outcomes. The effect of scalp acupuncture on emotional and behavioral problems in children with ASD was further elaborated in the second study. Our observation on patients noted drastic improvements in emotional and emotion-related behavioral problems after the introduction of scalp acupuncture. Feedbacks from parents also reflected a positive progress in performance on cognitive, social, and behavioral aspects after treatment. The influence of scalp acupuncture on the sleeping quality and habit in children with ASD was investigated in the third study. Children had shown less resistance and anxiety toward sleep after scalp acupuncture.

Keywords: effect, scalp acupuncture, treatment, autism, clinical study

1. Introduction

The prevalence of autism spectrum disorders (ASD) has been rising over the past 50 years. In 2017, statistics from WHO showed that one in every 160 children suffer from ASD [1]. The diagnosis of ASD emphasizes on specific presentations and malfunctions in various areas, including reciprocal social interaction, communication, and restricted and repetitive behaviors [2, 3].

Despite ASD being generally recognized as an incurable disease, numerous treatments have claimed to bring about major improvements or even recovery in autism. Various complementary and alternative medicine (CAM) treatments have been practiced to treat ASD. A study carried out in the United States reported that 74% of the children diagnosed with autism have ever tried one or more than one type of CAM treatments [4]. Among all the CAM available, scalp acupuncture has

been widely used for treating ASD in Hong Kong and China. In a treatment of scalp acupuncture, needles are inserted onto specific acupoints in accordance with different lines or zones of the scalp.

At present, a number of randomized controlled trials had been carried out to investigate the use of acupuncture in treating autism [5]. Despite present statistical evidence remaining inconclusive, there is no lack of subjective clinical reports and preliminary data to support the uses of acupuncture in improving communication, linguistic ability, cognitive and global functioning of ASD patients [5, 6].

The presentation of ASD could be observed in the early months of the children as they may manifest abnormal social development and speech delay before 1 year old. They are recognized as early-onset or natal autism [7]. On the other hand, a portion of children might obtain normal development in their first 18 months before losing previously acquired skills. This type of onset pattern is named as regressive or acquired autism [8]. We tried to relate the familial and personal allergic history and the onset pattern of the children.

A successive study has been made in the area of the effect of scalp acupuncture on emotion and behavioral functioning in those children. Despite behavioral problems having been evaluated in the first study, we had not distinguished emotion related behavior from restricted repetitive behavior. Studies have suggested that patients with ASD display more emotion deregulation than normal children [9]. Emotion disturbance always results in behavioral problems such as aggression, tantrums, and self-injurious behavior or comorbidity with other mental disorders like anxiety [10]. Currently few studies have been made in evaluating the use of scalp acupuncture in alleviating emotion and behavioral problems. Indeed we were impressed with how effective scalp acupuncture is in moderating emotion and its manifestation of children with ASD in our clinical observation.

Another area that has aroused our interest is the sleeping quality and habit in children with ASD. Previous studies have shown that children with ASD are more likely to have comorbidity with sleeping disorders. And the relationship between sleep and cognitive function has been evaluated [11]. Studies have shown that better sleeping quality may advocate better improvement in the symptomatology [12]. Since acupuncture has been vastly used in treating sleep disorder in adolescents and adults in certain cultures, we hypothesize that ASD children with similar sleep problems may as well benefit from scalp acupuncture.

2. Subjects and methods

2.1 Participants

Children with ASD consulted for acupuncture treatment at Hong Kong Baptist University Mr. & Mrs. Chan Hon Yin Chinese Medicine Specialty Clinic and Good Clinical Practice Centre were invited to join the studies. Eligibility criteria included children of both gender, aged 2–11 years old. All participants were required to present a current medical document on the diagnosis of ASD issued by recognized specialist such as pediatrician, psychiatrist, or psychologist.

In the first study, 68 patients with autism spectrum disorders participated; there were 11 female and 57 male. Ages ranged from 2.1 to 10.6 years old (mean = 4.2 years old) 47 (69%) natal autism cases and 21 (31%) regressive autism cases were included.

In the second study, 45 participants joined the program, consisting of 35 males and 10 females. Ages ranged from 2 to 10 years old (mean = 3.8 years old).

In the third study, 21 participants were invited to the investigation, including 20 males and 1 female. Age ranges from 2 to 10.1 years old (mean = 3.91 years old).

2.2 Therapist and treatment

All clinical assessment and scalp acupuncture treatment sessions were performed by principal investigator (Yau Chuen Heung), who is a registered Chinese medicine practitioner and has been performing scalp acupuncture for children with ASD and other developmental disorders for 18 years in Hong Kong.

The therapist and the treatment procedure were identical in the three studies. In each treatment session, the participants in the treatment group first sat on a chair or positioned in the bosom of their parents. Their scalps were then sterilized with a 75% alcohol cotton ball before acupuncture needles were obliquely inserted onto the selected acupoints with the depth of 10 mm into the subcutaneous tissue. The choice of acupoints included the BaiHui (GV20), SiShenChong (EX-NH3), midline of forehead, lateral line two of forehead, posterior lateral line of vertex, primary auditory cortex, and auditory speech area. The standard of needles used was 0.20 × 25 mm. Needles were swirled at intervals of 15 minutes before they were carefully removed and discarded after 60 minutes. Treatment sessions were performed twice a week and involved 30 sessions in the whole course.

2.3 Measurement of outcome

At the time participants joined the study, their past medical history and demographic information was recorded in an assessment session. Materials concerning the onset of ASD and familial and personal history of allergic diseases were also collected and manipulated in the first study. Participants who lose the previously acquired language skills were categorized into regression group, otherwise will be included into the natal group.

In the first study, in order to evaluate the overall performance of the participants, they were assessed by a parent-rated inventory adjusted childhood autism rating scale (CARS). We designed a set of rating scale for quantifying symptoms of ASD. The evaluated items covered social problem, verbal communication problem, behavioral problems, food selectivity, and noise sensitivity. The inventory was completed at the time (a) before scalp acupuncture treatment and (b) after 30 sessions of treatment.

In the second study, we utilized a parent questionnaire which was established in reference to autism behavior checklist (ABC) that covers five items of behavioral problems commonly found in child with ASD, which are temper tantrum, aggression to others, self-injury, impatience, and fears and anxiety. The checklist was finished at time (a) before scalp acupuncture treatment and (b) after 30 sessions of treatment. The marking scheme for refined CARS and ABC is listed on **Table 1**.

In the third study, a children sleeping habit questionnaire (CSHQ) was filled by parents to evaluate the sleep-related performance at the time (a) 6 months before receiving scalp acupuncture, (b) at the beginning of the treatment, and (c) after 6 months of treatment. CSHQ consists of 33 questions categorized into 8 domains, including bedtime resistance, sleep anxiety, sleep-onset delay, sleep waking, sleep-disordered breathing, parasomnia, daytime sleepiness, and night waking. Parents are required to record the frequency of the respective items which occurred in their children in the previous 2 weeks. A score will be marked according the frequency of the items.

Score	Marking Criteria
0	No symptoms
1	Minimal symptoms, seldom shown
2	Mild symptoms, often shown
3	Moderate symptoms, usually shown
4	Severe symptoms, always shown

Table 1.
Marking criteria for childhood autism rating scale (CARS) and autism behavior checklist (ABC).

Data analyses were conducted on all treatment responders. An alpha level of 0.05 was used for all statistical tests. The alteration in the score of CARS, ABC, and CSHQ throughout the studies was analyzed using paired t-test and analyses of variance (ANOVAs). The influence of age to the therapeutic effect was evaluated by means of independent t-test and ANOVAs. Pearson chi-square tests were utilized to show the correlation among onset patterns of ASD, personal history of allergic disorder, and family history of allergy. Calculations and analyses were performed on software IBM SPSS Statistics (Windows, version 21).

3. Results

In the first study, we investigated the effect of acupuncture on the general presentation of ASD patients (**Table 2** and **Figure 1**). Background performance before treatment scored highest in verbal communication problems, followed by social problems and behavioral problems. In comparison, the presentation of food selectivity and noise sensitivity problems seem to be less prominent issues.

A significant improvement across all items was observed after 30 sessions of scalp acupuncture treatment ($p < 0.05$). Among all domains, improvement made on social problems and verbal communication problems has been most prominent. Other items such as behavioral problems, food selectivity, and noise sensitivity showed relatively less effective toward acupuncture treatment.

In the later section of the first study, we tried to observe how the age of the children influence the effect of the treatment. The result was shown on **Figure 2**.

Items	Pre-treatment		Post-treatment		P-value
	Mean	SD	Mean	SD	
All	11.46	2.37	8.29	2.03	.000
Verbal communication Problems	3.06	1.01	2.00	0.90	.000
Social problems	2.50	0.78	1.60	0.69	.000
Behavioral problems	2.34	1.07	1.72	0.77	.000
Food selectivity	1.85	0.70	1.49	0.63	.000
Noise sensitivity	1.71	0.88	1.49	0.76	.003

Table 2.
Performance in selected items in childhood autism rating scale (CARS) before and after the scalp acupuncture treatment.

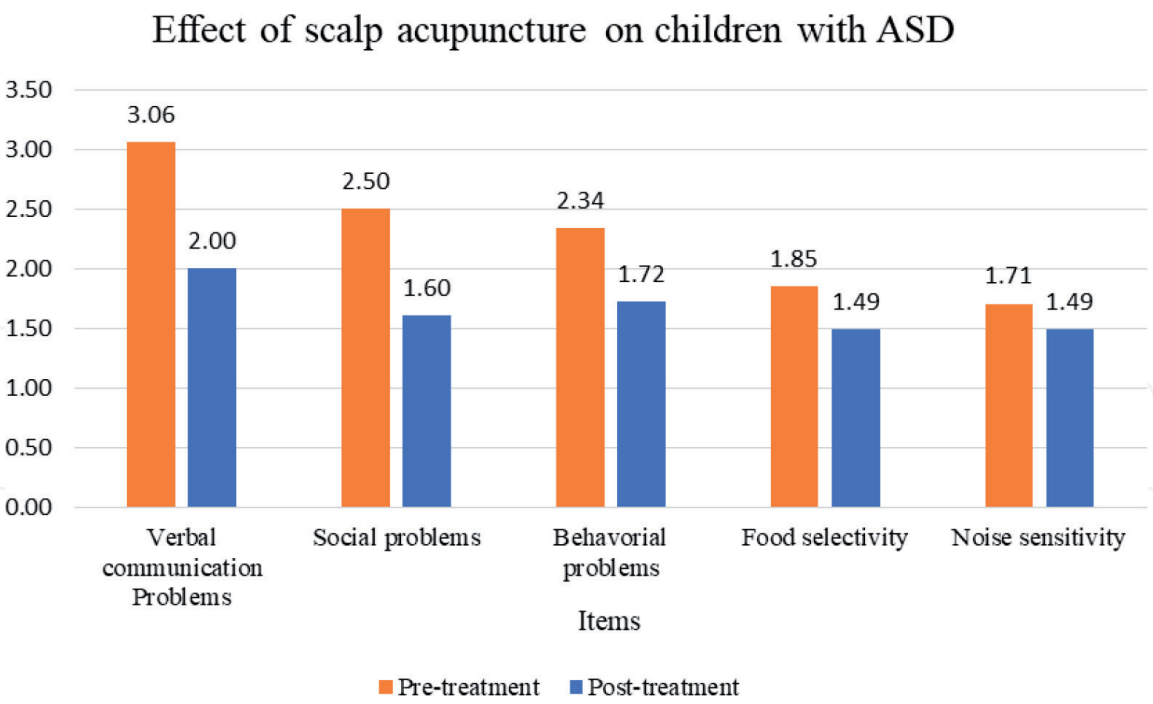


Figure 1.
Performance in selected items in childhood autism rating scale (CARS) before and after the scalp acupuncture treatment.

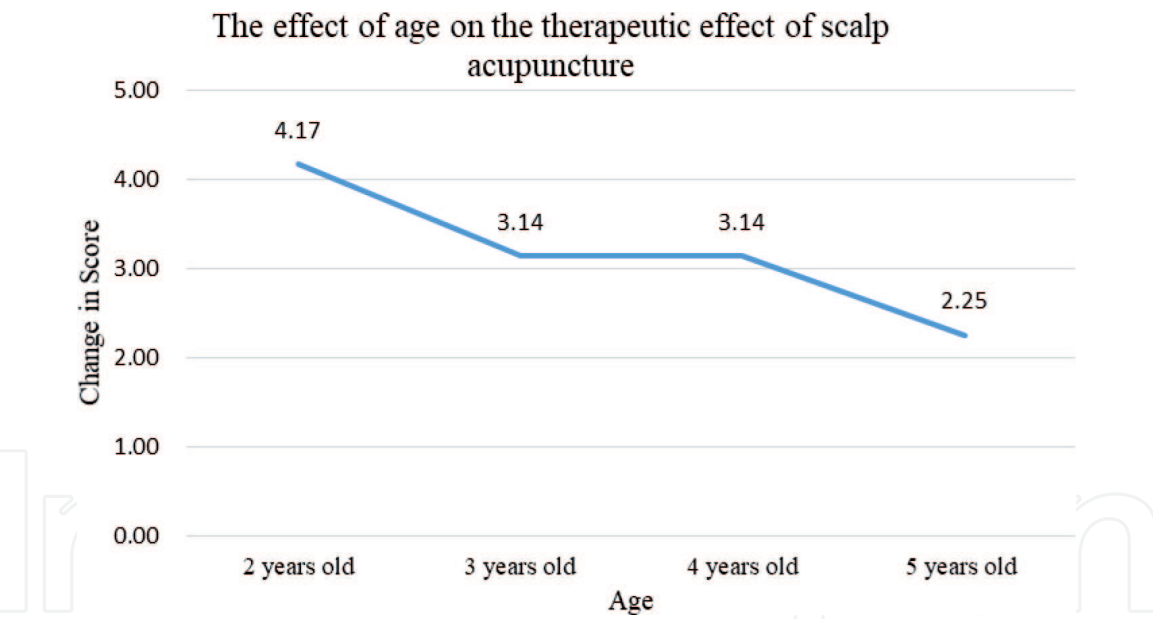


Figure 2.
The effect of age of the children on the therapeutic effect of scalp acupuncture treatment.

There is a significant downward trend of improvement along with an increase of age of the patients. Young children are more responsive to the scalp acupuncture and benefit more from the treatment, which cohere with our clinical observation.

The collected data obtained was further analyzed as we were interested in how regressive and natal-onset pattern varies in clinical presentation. Although no correlation between onset pattern and symptom severity could be established ($p > 0.05$), the familial occurrence of allergy disorder was found to closely related to the onset of ASD. Seventeen (25%) participants had shown various degree of allergic disorders such as allergic rhinitis, asthma, and eczema, while the remaining (75%) showed no history or relevant disorders. Around 29.4% ($n = 20$) participants' father or mother had a history of respiratory or

dermatologic allergic disorder, while the rest of 70.6% (n = 48) participants' parents did not. Further analyses revealed a significant correlation between family and personal history of allergy diseases (p = 0.000) and between family history of allergies and the onset type of ASD (p = 0.000). On the contrary, the factor of personal history of allergies had shown irrelevance to the onset pattern of ASD (p = 0.293).

In the second study, we focused on how scalp acupuncture can help with emotion and emotion-related behavioral problem in children with ASD. Comparing the score of ABC inventory before and after treatment, items in temper tantrum, aggression to others, impatience, and fears and anxiety received a significant positive progress with a range of 0.53–0.29 points (p < 0.05), whereas the alteration in the scoring of self-injury was blunt (p > 0.05). Individuals generally showed less frequent occurrence and milder presentation of temper tantrum, aggression, impatience, and anxiety after scalp acupuncture. However, the presentation of self-injurious actions did not show significant response toward treatment (**Table 3** and **Figure 3**).

Items	Pre-treatment		Post-treatment		P-value
	Mean	SD	Mean	SD	
Temper tantrum	1.53	1.06	1.00	0.80	.000
Aggression to others	0.96	1.19	0.53	0.89	.015
Self injury	0.33	0.64	0.24	0.48	.209
Impatience	1.96	1.00	1.53	0.97	.009
Fears and anxiety	0.78	0.97	0.49	0.69	.022

Table 3.
Performance in selected items in autism behavior checklist (ABC) before and after the scalp acupuncture treatment.

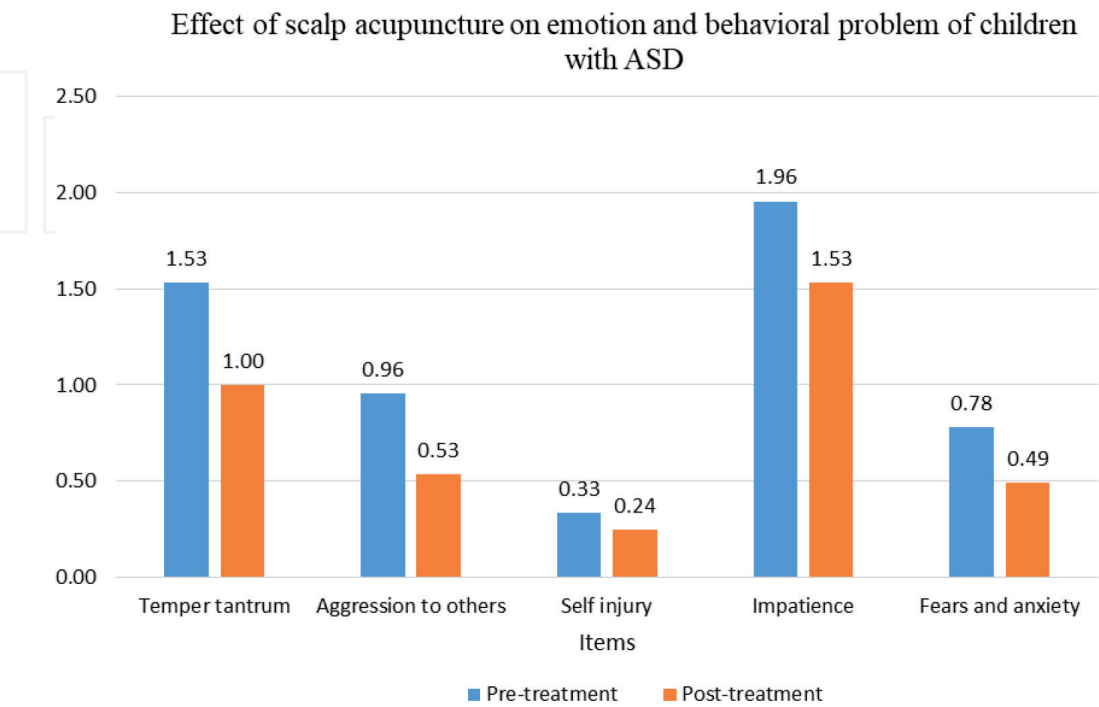


Figure 3.
Performance in selected items in autism behavior checklist (ABC) before and after the scalp acupuncture treatment.

Items	6 months prior to treatment			After 6 months of treatment		
	Mean	SD	P-value	Mean	SD	P-value
Total score	1.62	3.80	0.07	3.71	6.46	0.02
Bedtime resistance	0.48	1.83	0.25	0.90	1.34	0.01
Sleep onset delay	0.10	0.54	0.43	0.14	0.65	0.33
Sleep duration	0.19	0.75	0.26	0.33	1.11	0.18
Sleep anxiety	0.24	0.77	0.17	0.67	1.24	0.02
Sleep wakings	0.38	1.07	0.12	-0.14	1.28	0.61
Parasomnia	0.24	1.26	0.40	0.43	1.33	0.15
Sleep disordered breathing	0.24	0.62	0.10	0.29	0.96	0.19
Daytime sleepiness	-0.52	1.29	0.08	1.29	2.63	0.04

Table 4.
Comparison of the change in score of children sleeping habit questionnaire (CSHQ) between 6 months before treatment and after 6 months of scalp acupuncture treatment.

Our third study concerns about how scalp acupuncture alleviates sleeping problems encountered by children with ASD. The alteration in score of the eight subscales in the time periods “6 months prior to treatment” and “after 6 months of treatment” was shown in **Table 4**. The presentation in domains of bedtime resistance, sleep anxiety, and daytime sleepiness has shown significant improvement ($p < 0.05$) after 6 months of scalp acupuncture. In addition, we also observed an obvious decrease in the occurrence of nightmares reported after the introduction of the treatment ($p < 0.05$). However, no significant alteration was observed in the subscale of sleep-onset delay, night duration, sleep-disordered breathing, parasomnia, and sleep wakings.

4. Discussion

There are few theories proposed to explain the mechanism of scalp acupuncture on children with autism. Investigations had shown that acupuncture at the scalp can induce changes in perfusion in different brain areas. Biochemical alterations have also been noticed in individuals with ASD as they showed imbalances in level of catecholamine in blood and inside brain structures [13]. Acupuncture could correct and modulate respective catecholamine level [14]. Scalp acupuncture was observed to be able to improve defective brainwaves in brain diseases, which may also be applicable to children with ASD [15].

Theoretically, different areas and lines can be drawn on the scalp as a projection of functional areas of the cerebrum according to reflexology. Thus acupuncture at these areas was performed in order to stimulate the activity of the corresponding cerebral function. For example, the midline and the lateral line 2 of the forehead are in response to the prefrontal cortex of frontal lobes, posterior lateral line of vertex in response to posterior parietal lobe, auditory speech area in response to the Brodmann area 22, etc. We perceived that improvements in the cognitive ability such as verbal communication and social problems are more outstanding than sensory functions like sound sensitivity. Since hypoperfusion and the consequential under-development at the inferior portion of prefrontal lobe and left temporal speech area could be detected in individuals with ASD, malnourishment at these areas contribute to defects in language abilities, communication problems, and retarded cognitive development [16]. Scalp acupuncture can induce better perfusion to these structures, thus bringing prospective progress in cognitive and communication

development. On the contrary, the etiology of sensory dysfunction in ASD varies, result in differential responses among different developmental domains.

Moreover, auditory functioning in newborns becomes well-performed within days after labor. Infants are capable of discriminating sound frequency and intensity and making directional responses to sound at the first 3–6 months of age [17]. The rapid progress in gustatory and olfactory system provides infants with delicate sensory toward foods as early as they are 4–5 months old [18]. The early establishment of these sensory domains implies limited plasticity in altering the existing defective system by the time ASD is treated. In contrast, children develop language abilities at a slower rate for years before completing an effective communication system. The long duration of language and cognitive development with active neuroplasticity allows wider time window for receiving effective treatments.

Brain development continues to progress after birth through adolescence into Adulthood. It is most rapid in the first few years postnatal, given the fact that rate of increment in volume of white matter and gray matter in the cerebral cortex is the steepest during the first 2 and 4 years, respectively [19]. It may explain why children with age < 3 receive greater general therapeutic outcome from scalp acupuncture.

Strong correlation between familial or maternal atopic history and ASD has been well-recognized [20–23]. Molloy revealed familial autoimmune disease such as thyroid disease is a significant risk factor to the regressive onset of ASD [24]. Our investigation hints that familial atopies apart from thyroid disease, such as asthma, rhinitis, and eczema, also exhibit similar relationships.

Aggression and temper tantrum are commonly present in typically developing children. Children with psychiatric disorders, including ASD, have shown to have more aggressive behaviors and express exacerbated temper tantrums with greater emotional arousal lasting for longer period of time [25, 26]. After scalp acupuncture treatment, children with ASD might become gentler in temperament, their anger would be presented in a lower degree, and the duration of distress became shorter. Some children may even develop alternative coping strategies such as self-distraction and autosuggestion during stressful or undesirable events. We suggested that routine treatment sessions might pose a function of regular “emotion training,” allowing the children to develop volitional regulation of affects. Apart from the psychological point of view, physiological investigations have suggested structural and biochemical aspects of the brain which also contributes to the mental activity. Exaggerated temper tantrum, aggressive, or even violent behaviors have been related to the frontal (mainly ventromedial frontal and orbitofrontal cortex) and temporal lobe abnormalities, implying damages in the area or reduction in tissue volume and activities. A distinct dysfunction at the anterior cingulate cortex (ACC) was perceived in children with conduct misbehaviors using functional magnetic resonance imaging (fMRI) [27]. It was also recognized as the place where acupuncture exerts its effect [28]. Biochemical basis of ASD has also been intensively studied. Patients with ASD often feature with hyperserotonemia conditions, resulting in unstable temperament and aggressive behaviors of an individual [29]. Since acupuncture was suggested to deliver its therapeutic effect by regulating serotonin level, it may explain how acupuncture brings about alteration in mood and behaviors of ASD individuals [14].

Concerning about the effect of scalp acupuncture on the performance of sleep in children with ASD, prominent improvements have been shown on items which are associated with emotional and behavioral components, i.e., bedtime resistance and anxiety. We suggest the effect of the treatment to be the consequence of the ameliorated emotion and behavior problems. Surprisingly, distressing and prominent sleep problems commonly found in children with ASD including irregular sleep-wake patterns or sleep wakings did not response well toward scalp acupuncture therapy. Neurobiological studies have suggested the aberration in neurotransmitter

systems, including gamma-aminobutyric acid (GABA), serotonin, and melatonin, may be responsible for sleep disturbance in ASD [30]. Regarding the complexity and interactive nature of the contributing biological, psychological, and environmental factors in ASD [31], although acupuncture was proposed to be capable of modulating the deviated neurotransmitter system [32], no obvious improvement on circadian abnormalities has been detected in this study.

Although our studies showed encouraging outcomes in using scalp acupuncture on children with ASD, enormous efforts are required to further evaluate its clinical application and to understand the underlying mechanism. Since no comparison or controlled group was used in these studies, further randomized controlled trials are desirable. High-quality trials of larger sample size and longer follow-up period are needed to provide objective and definitive evidences on the therapeutic value of scalp acupuncture treatment on patients with ASD.

5. Conclusion

According to our preliminary studies, ASD manifestations of some aspects such as verbal communication, social, and behavioral problems may obtain significant improvement upon the introduction of acupuncture, whereas domains of food selectivity and auditory sensitivity benefit less in the process. Scalp acupuncture may also be effective in alleviating temper tantrum and aggression problems in children with ASD. It can facilitate emotion regulation on anger and diminish the frequency and the intensity of the related behavior. Comorbid sleep disorders likewise benefit from scalp acupuncture. The domains of bedtime resistance, sleep anxiety, daytime sleepiness, and nightmare have shown significant amelioration upon the introduction of the treatment.

Age is a predictor for the therapeutic effect of acupuncture. Early intervention is always encouraged for ASD children. Moreover, a significantly greater proportion of regressive-onset ASD patients shared positive familial allergy history than natal-onset ASD. Correlation between family history of atopy and onset type stated the difference in the nature of natal and regressive ASD.

Despite the rapid development of modern science, the incidence rate of ASD shows no sign of decline and ASD remains to be an incurable disorder. Only if we could reveal factors that contribute to the onset of ASD, preventive measures or effective treatments could be applied. Besides, further investigations are required in order to reveal the underlying mechanism of acupuncture, i.e., the psychological and physiologic effect of scalp acupuncture on children with ASD.

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List of abbreviations

ABC	autism behavior checklist
ACC	anterior cingulate cortex
ASD	autism spectrum disorders

CAM	complementary and alternative medicine
CARS	childhood autism rating scale
CSHQ	children sleeping habit questionnaire
fMRI	functional magnetic resonance imaging
GABA	γ -aminobutyric acid
WHO	World Health Organization

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