

Effect of Negative Air Ions on Biochemical Parameters and Cognitive Functions in Cerebral Palsy Patients

Ammara Rafique, Hajra Naz

Department of Biochemistry, University of Karachi, Pakistan

*E-mail: ammararafique92@gmail.com

ABSTRACT

Cerebral Palsy (CP) is a neurological disorder that begins with the formation of brain lesions in the fetal, infancy, or early childhood developmental periods. Numerous studies have reported the therapeutic effects of negative air ions (NAIs) for many ailments. This study explored the effect of NAIs on biochemical parameters and cognitive functions in CP-inflicted patients. After obtaining ethical approvals, thirty-one structured sessions of a 40-minute exposure to 10000 negative ions/cm³ were conducted with the intervention group after randomly allocating participants to control (n=12) and intervention (n=16) groups. 12 biochemical parameters and 5 Lumsity games were employed for the study. Paired t-tests presented amelioration of some of the biochemical parameters within normal range indicating that an environment enriched in NAIs is innocuous for CP-inflicted patients. Significant improvement in cognitive functions may be due to enhanced activity of the brain regions likely the cerebral cortex, prefrontal cortex, and parietal lobe as well as the neurotransmitter serotonin in the intervened group. Based on our findings, we suggest the inclusion of NAIs as an intervention for the holistic betterment of CP-inflicted patients.

Keywords: Biochemistry, Cerebral Palsy, Cognition, Negative ions, Neurorehabilitation

INTRODUCTION

Cerebral Palsy (CP) is a neurological disorder that begins with the formation of brain lesions in the fetal, infancy, or early childhood developmental periods. CP affects 1.5-4/1000 live births [1] and is more dominant in males [2]. CP causes abnormalities in academic performance, biochemical parameters, motor movement, swallowing, and other functions. Cognitive function is a mental skill for gathering and processing information to perform a task. Cognitive functioning is also impaired in 50% of CP cases. Negative ion generators are electric devices that generate negative air ions (NAIs). Numerous studies have reported the therapeutic effects of NAIs in improving memory, anti-depressant effects, fertility, productivity, psychological health, and well-being by inducing alkalinity in the body [3-5]. The current study was aimed to explore the effect of NAIs on biochemical parameters and cognitive functions in CP-inflicted patients as to the best of our knowledge, there is no evidence-based study pertaining to this topic.

OBJECTIVE

To explore the effect of NAIs on biochemical parameters and cognitive functions in CP-inflicted patients.

METHODOLOGY

This study was conducted in the year 2021 at Al-Umeed Rehabilitation Association (AURA), Karachi, Pakistan after obtaining ethical approval. Rules of the Helsinki Declaration were kept into consideration. Altogether 30 parents gave consent, but 2 irregular participants were excluded. Concealed method of randomization was used by the administrator of AURA to allocate participants in the control (n=12, 1 female & 11 males aged 14 ± 5 years) and the intervention groups (n=16, 8 females & 8 males aged 14.5 ± 7.1 years). Both groups continued

their regular therapies at the AURA, but the intervention group also received 40-minute exposure to 10000 ions/cm³ for 6 weeks using a negative ionizer ‘JHQ- 801’ in an enclosed classroom. ‘KT-401 mini air ion tester counter’ was used to ensure the presence of 10000 ions/cm³ during each session. For biochemical assessment, the tests for total proteins, albumin, globulin, A/G ratio, random sugar, blood urea nitrogen, creatinine, calcium, sodium, potassium, chloride, and bicarbonate were performed. For cognitive assessment, Lumosity software was purchased online, and 5 games were selected which encompassed lost in migration, highway hazards, tidal treasure, space trace, and masterpiece to evaluate selective attention, information processing, working memory, spatial fluency, and spatial reasoning respectively. Participants of both groups were assessed at baseline (First time), and in the sixth week (Second time). It was a within-group design so, paired t-tests were performed using SPSS v28.

CONCLUSION / RESULT

The biochemical parameters of all participants were in the normal range and remained unaltered at the evaluation in the sixth week. Paired t-tests showed significantly increased blood urea nitrogen ($p < 0.01$), chloride ($p < 0.001$), creatinine ($p < 0.01$), and sodium ($p < 0.001$) in the control group whereas, significantly increased chloride ($p < 0.01$), creatinine ($p < 0.01$), globulin ($p < 0.05$), sodium ($p < 0.001$) and total proteins ($p < 0.01$) and significantly decreased A/G ratio ($p < 0.05$) in intervention group (Table 1). The amelioration of these parameters in the intervention group indicates that an environment enriched in NAIs is innocuous for them.

Table 1. Paired t-tests for biochemical parameters.

Tests	Group	Baseline		Sixth week		p-value
		Mean±SD	SE	Mean±SD	SE	
Total proteins	Control	7.6±0.3	0.11	7.8±0.4	0.12	0.09
	Intervention	7.5±0.4	0.10	7.8*±0.3	0.09	0.01
Albumin	Control	4.6±0.3	0.09	4.8 ±0.3	0.10	0.07
	Intervention	4.5±0.2	0.07	4.6 ±0.2	0.06	0.19
Globulin	Control	2.9±0.2	0.07	3±0.2	0.05	0.30
	Intervention	2.9±0.4	0.11	3.1*±0.4	0.10	0.01
A/G ratio	Control	1.6±0.2	0.05	1.61±0.14	0.04	0.75
	Intervention	1.5±0.2	0.07	1.48*±0.21	0.05	0.04
Random sugar	Control	83.9±11.9	3.44	87.5±15.4	4.47	0.46
	Intervention	90.0±18.2	4.56	94.1 ± 18.5	4.63	0.25
Blood urea nitrogen	Control	10.4±3.23	0.93	11.9**±3.72	1.07	0.004
	Intervention	11.1±3.05	0.76	11.0±2.11	0.52	0.88
Creatinine	Control	0.55±0.17	0.04	0.65**±0.17	0.04	0.003
	Intervention	0.48±0.14	0.03	0.53**±0.16	0.04	0.006
Calcium	Control	9.83±0.30	0.08	9.85±0.35	0.10	0.79
	Intervention	9.70±0.41	0.10	9.82±0.39	0.09	0.10
Sodium	Control	139.1±0.90	0.26	144.5***±2.24	0.64	0.000
	Intervention	139.5±2.09	0.52	144***±2.07	0.51	0.000
Potassium	Control	4.59±0.39	0.11	4.39±0.33	0.09	0.19
	Intervention	4.47±0.38	0.09	4.35±0.42	0.10	0.25
Chloride	Control	102.9±1.00	0.29	105***±1.55	0.44	0.000
	Intervention	102.6±2.04	0.51	104.6**±2.64	0.66	0.006
Bicarbonate	Control	28.4±1.08	0.31	28.4±1.67	0.48	1
	Intervention	29.3±1.62	0.40	28.4±1.45	0.36	0.06

Values are ‘Mean±SD’ and are significant at ‘* $p < 0.05$ ’, ‘** $p < 0.01$ ’, and ‘*** $p < 0.001$ ’. SE is ‘Standard error’.

In cognitive evaluation, we observed significantly improved spatial reasoning ($p < 0.05$) in the control group whereas selective attention ($p < 0.01$), information processing ($p < 0.001$), spatial fluency ($p < 0.01$), and spatial reasoning ($p < 0.01$) were significantly improved in the intervention group (Figure 1) at the sixth week. The brain is a malleable organ that can reinstate its connections and the improvement in cognitive functions may be due to enhanced activity of the brain regions likely the cerebral cortex, prefrontal cortex, and parietal lobe as well as the neurotransmitter serotonin. Environmental enrichment techniques are effective for CP-inflicted patients [6] so, based on our findings we suggest that an environment enriched in NAIs can be a part of such techniques for the holistic betterment of such patients.

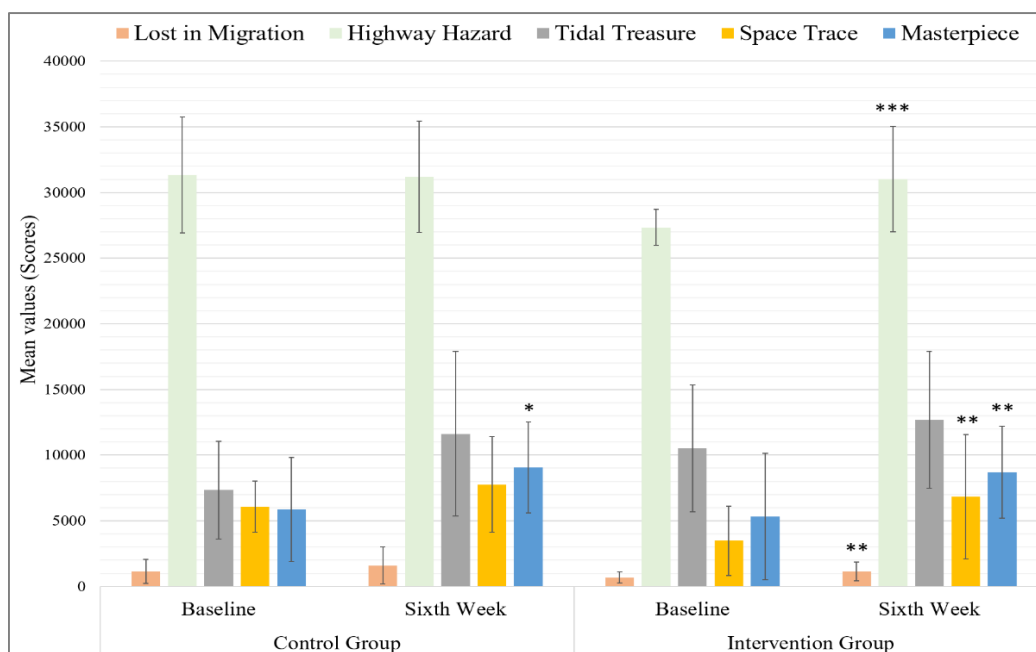


Figure 1. Significant values using paired t-test are denoted as ‘ $p < 0.05$ ’, ‘ $p < 0.01$ ’, and ‘ $p < 0.001$ ’ whereas error bars are the ‘standard deviations’.

ACKNOWLEDGMENT

We are thankful to the authorities and staff of AURA. We are also grateful to ‘The Laboratory’ for allowing us to perform tests at his lab.

REFERENCES

1. Krigger, Karen W. "Cerebral palsy: an overview." *American family physician* 73.1 (2006): 91-100.
2. Rafique, Ammara, and Hajra Naz. "A survey-based report on the occurrence of cerebral palsy in Urban areas of Karachi." *Journal of Pakistan Medical Association* 70.8 (2020): 1442-1444.
3. Jiang, Shu-Ye, Ali Ma, and Srinivasan Ramachandran. "Negative air ions and their effects on human health and air quality improvement." *International journal of molecular sciences* 19.10 (2018): 2966.
4. Pino, Olimpia, and Francesco La Ragione. "There’s something in the air: Empirical evidence for the effects of negative air ions (NAI) on psychophysiological state and performance." *Research in Psychology and Behavioral Sciences* 1.4 (2013): 48-53.
5. Naz, Hajra, and Darakhshan J. Haleem. "Exposure to illuminated salt lamp increases 5-HT metabolism: A serotonergic perspective to its beneficial effects." *Pakistan Journal of Biochemistry and Molecular Biology* 43.2 (2010): 105-108.
6. Rehman, Anum, Ammara Rafique, and Hajra Naz. "Effectiveness of environmental enrichment techniques on spastic diplegia and behavioral modulation of three cerebral palsy Pakistani children." *International Journal of Scientific & Engineering Research* 10.12 (2019): 228-232.