

REAC neuromodulation treatments in subjects with severe socioeconomic and cultural hardship in the Brazilian state of Pará: a family observational pilot study

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Purpose: The purpose of this preliminary observational study was to evaluate the usefulness of a humanitarian initiative, aimed at improving the neuropsychological and behavioral attitude of children with severe socioeconomic and cultural hardship, in the Brazilian state of Pará. This humanitarian initiative was realized through the administration of two neuromodulation protocols, with radioelectric asymmetric conveyor (REAC) technology. During several years of clinical use, the REAC neuromodulation protocols have already proved to be effective in countering the effects of environmental stress on neuropsychophysical functions.

Patients and methods: After the preliminary medical examination, all subjects were investigated with the Strengths and Difficulties Questionnaire (SDQ), including the impact supplement with teacher's report. After the SDQ, they received the neuromodulation treatment with REAC technology named neuro postural optimization (NPO), to evaluate their responsiveness. Subsequently, every 3 months all subjects underwent a treatment cycle of neuropsychophysical optimization (NPPO) with REAC technology, for a total of three cycles. At the end of the last REAC-NPPO treatment cycle, all subjects were investigated once again with the SDQ. For the adequacy of the data, the Wilcoxon and the Signs tests were used. For the subdivision into clusters, the Kruskal–Wallis test was applied for the adequacy of the procedure. For all the applied tests, a statistical significance of $p < 0.5$ was found.

Results: The results showed that the REAC-NPO and REAC-NPPO neuromodulation protocols are able to improve the quality of life, the scholastic and socialization skills, and the overall state of physical and mental health in children of a family with severe socioeconomic and cultural hardship.

Conclusion: The REAC-NPO and REAC-NPPO neuromodulation protocols, due to their non-invasive characteristics, painlessness, and speed of administration, can be hypothesized as a treatment to improve the overall state of physical and mental health in a large number of people with socioeconomic and cultural discomfort.

Keywords: socioeconomic hardship, socioeconomic disparities, neuromodulation, radioelectric asymmetric conveyor, neuro postural optimization, neuropsychophysical optimization

Introduction

Socioeconomic inequalities have strong influences on health,^{1–4} education, and school careers.^{5,6} As interventions to face this situation are often complex and expensive, socioeconomic and cultural disparities are becoming progressively larger, with serious repercussions affecting all aspects of social life.

This preliminary phase of investigation was carried out to evaluate the usefulness of a humanitarian initiative, aimed at improving the quality of life of families with severe socioeconomic and cultural distress, residing in the Brazilian state of Pará.

The aim of this study was to test if a sequence of two different neuromodulation protocols with radioelectric asymmetric conveyor (REAC) technology can improve the psychophysical state of subjects in severe socioeconomic and cultural hardship. In order to have a sample as homogeneous as possible, we chose to treat the members of a family group.

The two REAC neuromodulation protocols used were the neuro postural optimization (NPO) and the neuropsychophysical optimization (NPPO). The REAC-NPO protocol has proved to be effective in optimizing encephalic electrometabolic functions, by inducing long-lasting changes in brain activation⁷⁻⁹ also in subjects with Alzheimer's^{10,11} and other neurological diseases.¹²

The REAC-NPPO protocol has proven to be effective in treating stress-related symptoms,¹³⁻¹⁸ such as anxiety,¹⁹⁻²¹ pain,¹⁶ depression,^{19,20,22} and other psychiatric disorders²³⁻²⁵ also related to adaptation disorder.^{13,26-28} These two REAC neuromodulation protocols are absolutely non-invasive, painless and very fast and easy to be administered. Due to these characteristics, they could be ideal to treat a large number of subjects, in policies aimed to promote health and quality of life.

Patients and methods

Ethics

This observational study was conducted in full compliance with the Declaration of Helsinki – Ethical principles for medical research involving human subjects and according to a study protocol approved by Comit  de  tica independente IRB – IEC, Governo do Estado do Par , Secretaria de Estado de Educa o, Escola Estadual de Ensino Fundamental e M dio “Rodrigues Pinag ,” with protocol number 0108/16 dated August 4, 2016. The father of the selected family provided written informed consent for the therapeutic treatment and for the case details to be published.

Aim, design, and setting of the study

This preliminary feasibility phase focused on one family group, in order to have a sample of subjects as homogeneous as possible and to minimize the influence of environmental variables.

The recruitment was done in a school attended by students with families in severe socioeconomic and cultural distress. The local school director invited students' families to join the study on a voluntary basis and without any remuneration.

Among the families that had joined, the school director selected a family consisting of the parents and five children, with particularly severe socioeconomic hardship.

Characteristics of participants

Upon initial medical examination, all the family members showed various types of wounds and injuries, edema, and bruises on the body.

Subject 1: male, 13 years old, during the first medical examination showed a general delayed physical and mental development, with short stature and cognitive impairment, difficulty in pronouncing intelligible words, aggressive attitudes and rapid behavioral changes, disobedience to rules or commands, difficulty in socialization with his classmates, poor school performance, and extreme difficulty in falling asleep. The boy also showed the triad: inattention, hyperactivity, impulsiveness, typical of attention-deficit hyperactivity disorder (ADHD).

Subject 2: female, 11 years old, during the first medical examination showed difficulty in the organization of language, difficulty in pronouncing intelligible words, difficulty in socialization with her classmates, poor school performance, an extreme difficulty in falling asleep, and spending the night watching television.

Subject 3: female, 8 years old, during the first medical examination showed difficulty in verbal communication, with use of few words but in a clear and consistent way, difficulty in learning and in memory. She was not able to perform simple activities like associating numbers with colors and remembering the information provided by the evaluator. Moreover, she showed disobedience to rules or commands, poor school performance, and forefoot gait. She had easy crying crises during interpersonal interaction.

Subject 4: female, 6 years old, during the first medical examination showed a state of psychic agitation, aggressive attitude, crying crises, disobedience to rules or commands, difficulty in speaking and expressing sounds in an organized way, difficulty of fine motor control, and forefoot gait.

Subject 5: male, 5 years old, during the first medical examination showed cleft palate with previous surgical correction of cleft lip only. Moreover, he showed a state of psychic agitation, aggressive and jealous attitude, and difficulty in pronouncing intelligible words, difficulty in concentrating, memory problems and slow thinking, disobedience to rules or commands, and fear of sharp objects.

Interventions and comparisons

During the first medical examination, all subjects were investigated for the presence of fluctuating asymmetries (FAs).

FA refers to small random deviations from perfect symmetry in bilaterally paired structures.²⁹ FA reflects the organism's ability to cope with genetic and environmental stress during development.²⁹ FA can also indicate developmental stability and suggest the genetic fitness of an individual³⁰ as an epigenetic measure of environmental stress^{31–33} and ADHD.³⁴ The analysis of the FA can be performed by observing the morphological differences between the two hemisomes, in particular at face level.^{35,36} The analysis of FA can be performed also at functional level by observing the asymmetric activation of symmetrical muscle groups, such as the quadriceps femoris during the transition from the supine to the sitting position, during a motor task.^{8–11} The phenomenon thus observed takes the name of functional dysmetria.^{8,9} All subjects showed facial asymmetry and functional dysmetria.

After this first evaluation, all the subjects were investigated with the Strengths and Difficulties Questionnaire (SDQ).^{37–42} We have used the SDQ and Impact Supplement for the teachers specifically for 4–17 year olds. The SDQ Impact Supplement allows us to sum up the items on overall distress and impairment of the subject and generate an impact score. In fact, the teacher assesses whether the subject has difficulties in emotions, concentration, behavior, or being able to get on with other people and whether these difficulties upset or distress the subject and interfere with his or her everyday life. The teacher also assesses whether the difficulties of the subject constitute a burden for the teacher him- or herself or for the class as a whole.

A psychopedagogue assessed the subjects involved with the SDQ before the administration of the REAC-NPO protocol (T0) and immediately after the end of the third cycle of REAC-NPPO (T1).

Description of REAC technology

REAC for therapeutic use is a technology platform for biomodulation^{28,43–61} and neuromodulation,^{7,8,10,11,13–27,62} which has been shown to be effective even in neurodegenerative diseases.^{57,60} The scientific background of the REAC technology platform is based on a fundamental phenomenon for life: the cell polarity. Cell polarity is the asymmetric organization of several cellular components, including the plasma membrane, cytoskeleton, and organelles.⁶³ This asymmetry can be used for specialized functions, such as maintaining a barrier within an epithelium or transmitting signals in neurons.^{64,65} The purpose of REAC technology is to recover and optimize the correct cell polarity.

The REAC-NPO neuromodulation protocol has been shown to be able to optimize neurotransmission in the whole encephalic mass, determining a more functional and

economic response,^{7–9} also in neurodegenerative diseases such as Parkinson's and Alzheimer's.^{10–12} The REAC-NPO protocol consists of a single-administration treatment, which lasts for around 1 second. The REAC-NPPO neuromodulation protocol has been shown to optimize and improve the coping capacity toward environmental stressors^{13–19} and to be effective in various psychiatric disorders.^{20–26} The REAC-NPPO neuromodulation protocol consists of a treatment cycle of 18 sessions. Each session lasts for around 3 seconds. Every 3 months, the children underwent REAC-NPPO treatment cycles, for a total of three cycles. At the end of the last REAC-NPPO treatment cycle, they were investigated once again with the SDQ. None of the participants was subjected to any type of parallel treatment during the REAC-NPPO neuromodulation treatment cycles and the observation phase.

The REAC device used was a BENE model (ASMED, Florence, Italy).

Statistical analysis

For statistical analysis, we used IBM Statistical Package for Social Science (SPSS) 22.

The data collected with the SDQ have been analyzed with statistical tests and performed to check the adequacy of the data and procedure. For the adequacy of the data, Wilcoxon tests were used (Asymp, Sig two-tailed 0.013–0.196) and the Signs (Exact, Sig two-tailed 0.012–0.454). Regarding the subdivision into clusters (emotional problems, conduct problems, hyperactivity, peer problems, and prosocial), the Kruskal–Wallis test was applied for the adequacy of the procedure. For all the applied tests, a statistical significance of $p < 0.5$ was found.

Results

Subject 1: his Total Difficulties Score, generated by summing scores from all the scales except the prosocial scale, has improved from 32 at T0 (before REAC-NPPO), which corresponds to the Abnormal categorization, to 14 at T1 (after the end of the third REAC treatment cycle), which corresponds to the Borderline categorization. After the third REAC-NPPO neuromodulation treatment cycle, his score has moved to the threshold of Normality on all scales. In particular: emotional problems scale: total score from 5 = borderline to 3 = normal; conduct problems scale: total score from 9 = abnormal to 4 = normal; hyperactivity scale: total score from 9 = abnormal to 4 = normal; peer problems scale: total score from 9 = abnormal to 3 = normal (Tables 1 and 2). Moreover, during the REAC neuromodulation treatment cycles, he showed improvement in sleep quality and school performance.

Table 1 SDQ teacher questionnaire results

Teacher's assessment	Subject 1		Subject 2		Subject 3		Subject 4		Subject 5	
	Before	After	Before	After	Before	After	Before	After	Before	After
Emotional problems scale	5	3	8	3	4	2	3	2	4	3
Often complains of headaches	Borderline	Normal	Abnormal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Many worries	2	1	2	0	1	0	0	0	0	0
Often unhappy, downhearted	0	1	2	1	0	1	0	1	0	0
Nervous or clingy in new situations	1	0	2	1	1	0	0	2	2	1
Many fears, easily scared	2	1	1	1	2	1	2	1	0	1
Conduct problems scale	0	0	1	0	0	0	1	0	2	1
Often has temper tantrums or hot tempers	9	4	4	1	2	0	7	3	4	3
Generally obedient	Abnormal	Abnormal	Abnormal	Normal	Normal	Normal	Abnormal	Borderline	Abnormal	Borderline
Often fights with other children	2	1	2	1	1	0	2	1	2	1
Often lies or cheats	2	1	0	0	0	0	2	1	0	1
Steals from home, school, or elsewhere	2	1	1	0	0	0	0	0	0	0
Hyperactivity scale	1	0	0	0	0	0	1	0	0	0
Restless, overactive	9	4	4	2	6	2	9	5	8	7
Constantly fidgeting or squirming	Abnormal	Normal	Normal	Normal	Borderline	Normal	Abnormal	Normal	Abnormal	Abnormal
Easily distracted, concentration wanders	2	0	0	0	1	0	2	1	2	1
Thinks things out before acting	2	1	2	1	2	1	2	1	0	1
Sees tasks through to the end	2	2	1	0	1	0	2	1	2	2
Peer problems scale	2	3	8	4	5	3	7	4	7	2
Rather solitary, tends to play alone	Abnormal	Normal	Abnormal	Borderline	Abnormal	Normal	Abnormal	Borderline	Abnormal	Normal
Has at least one good friend	2	0	2	1	1	0	0	0	2	0
Generally liked by other children	2	1	1	1	1	1	2	1	0	0
Picked on or bullied by other children	2	0	1	0	0	0	2	1	1	0
Gets on better with adults than with other children	1	2	2	2	2	2	2	2	2	2
Prosocial scale	3	6	3	8	5	9	3	6	3	5
Considerate of other people's feelings	Abnormal	Normal	Abnormal	Normal	Borderline	Normal	Abnormal	Normal	Abnormal	Borderline
Shares readily with other children	0	1	0	2	1	2	0	1	0	1
Helpful if someone is hurt	0	0	1	1	1	2	0	1	0	1
	0	2	0	1	1	2	1	1	0	1

Abbreviation: SDQ, Strengths and Difficulties Questionnaire.

Table 2 SDQ score table

	Normal	Borderline	Abnormal
Total difficulties score	00–11	12–15	16–40
Emotional problems score	00–04	5	06–10
Conduct problems score	00–02	3	04–10
Hyperactivity score	00–05	6	07–10
Peer problems score	00–03	4	05–10
Pro-social score	06–10	5	00–04

Abbreviation: SDQ, Strengths and Difficulties Questionnaire.

Subject 2: her Total Difficulties Score, generated by summing scores from all the scales except the prosocial scale, has improved from 24 at T0 (before REAC-NPPO), which corresponds to the abnormal categorization, to 10 at T1 (after the end of the third REAC-NPPO treatment cycle), which corresponds to the normal categorization. In particular: emotional problems scale: total score from 8 = abnormal to 3 = normal; conduct problems scale: total score from 4 = abnormal to 1 = normal; hyperactivity scale: total score from 4 = normal to 2 = normal; peer problems scale: total score from 8 = abnormal to 4 = borderline (Tables 1 and 2). Moreover, during the REAC neuromodulation treatment cycles, she showed improvement in sleep quality and school performance.

Subject 3: her Total Difficulties Score, generated by summing scores from all the scales except the prosocial scale, has improved from 17 at T0 (before REAC-NPPO), which corresponds to the abnormal categorization, to 7 at T1 (after the end of the third REAC-NPPO treatment cycle), which corresponds to the normal categorization. In particular: emotional problems scale: total score from 4 = normal to 2 = normal; conduct problems scale: total score from 2 = normal to 0 = normal; hyperactivity scale: total score from 6 = borderline to 2 = normal; peer problems scale: total score from 5 = abnormal to 3 = normal (Tables 1 and 2). Moreover, during the REAC neuromodulation treatment cycles, she started to walk correctly and improved her school performance.

Subject 4: her Total Difficulties Score, generated by summing scores from all the scales except the prosocial scale, has improved from 26 at T0 (before REAC-NPPO), which corresponds to the abnormal categorization, to 14 at T1 (after the end of the third REAC-NPPO treatment cycle), which corresponds to the borderline categorization. In particular: emotional problems scale: total score from 3 = normal to 2 = normal; conduct problems scale: total score from 7 = abnormal to 3 = borderline; hyperactivity scale: total score from 9 = abnormal to 5 = normal; peer problems scale: total score from 7 = abnormal to 4 = borderline

(Tables 1 and 2). Moreover, she improved her ability to pronounce intelligible words.

Subject 5: his Total Difficulties Score, generated by summing scores from all the scales except the prosocial scale, has improved from 23 at T0 (before REAC-NPPO), which corresponds to the abnormal categorization, to 15 at T1 (after the end of the third REAC-NPPO treatment cycle), which corresponds to the borderline categorization. In particular: emotional problems scale: total score from 4 = normal to 3 = normal; conduct problems scale: total score from 4 = abnormal to 3 = borderline; hyperactivity scale: total score from 8 = abnormal to 7 = abnormal; peer problems scale: total score from 7 = abnormal to 2 = normal (Tables 1 and 2). Moreover, he improved his motor control and gait and his communication ability, starting to pronounce short words.

All the subjects involved showed a marked improvement compared to their initial state, as shown by the passage of category of their scores, according to the SDQ Impact Supplement score table for 4–17 year olds (Tables 3 and 4).

Discussion

The growing socioeconomic and cultural disparities represent a serious social problem,⁶⁶ which has been exacerbating in recent years. An attempt to reduce this social gap is the activation of sustainable initiatives to improve the mental and physical health of the disadvantaged population,^{67–69} in order to allow a positive socioeconomic and cultural evolution of this population. For this purpose, it may be useful to choose approaches that do not require understanding and social interaction, since subjects belonging to disadvantaged populations often have severe limitations in these abilities.⁷⁰ Furthermore, the natural distrust of these populations^{71,72} requires simple approaches, easy to be administered, and non-invasive both at the physical and mental level. The REAC-NPO and REAC-NPPO neuromodulation protocols have been specifically designed to be administered to large numbers of people, in a simple and effective way, avoiding interpersonal conditioning.

The experience carried out in this preliminary phase of this humanitarian initiative confirms that the REAC-NPO and REAC-NPPO neuromodulation protocols are effective in improving the neuropsychophysical pictures,^{10–27,62} even in subjects who do not have clear cultural skills to understand the usefulness of the treatment they receive.

Although the efficacy of REAC neuromodulation protocols in improving the neuropsychophysical response to environmental interaction has already been demonstrated,^{13–17,19}

Table 3 SDQ impact supplement score results

Impact supplement	Subject 1		Subject 2		Subject 3		Subject 4		Subject 5	
	Before	After	Before	After	Before	After	Before	After	Before	After
Difficulties upset or distress child	2	0	1	0	1	0	2	0	2	0
Interfere with friendships	2	0	1	0	1	0	1	0	2	0
Interfere with classroom learning	2	0	1	0	1	0	Preschool age	Preschool age	Preschool age	Preschool age
Total impact supplement score	6	0	3	0	3	0	3	0	4	0

Abbreviation: SDQ, Strengths and Difficulties Questionnaire.

Table 4 SDQ impact supplement score table

Teacher assessment	Abnormal	Borderline	Normal
Total score	≥2	1	0

Abbreviation: SDQ, Strengths and Difficulties Questionnaire.

it is the first time that these treatments have been used for the same intended use, but in a population defined with severe socioeconomic and cultural hardship. For this reason, it will be appropriate to proceed with a larger sample, to better understand the impact of these REAC neuromodulation protocols in improving neuropsychological and behavioral attitude of these populations.

Conclusion

The experience and results achieved in the preliminary phase of this humanitarian initiative seem to prove that REAC-NPO and REAC-NNPO neuromodulation protocols, due to their non-invasive characteristics, painlessness, and speed of administration, can be hypothesized as a treatment to improve the overall state of physical and mental health in a large number of people with socioeconomic and cultural hardship.⁷³

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Author contributions

JACP conceived and designed the experimental plan, wrote the manuscript, and performed the experiments. AR conceived and designed the experimental plan, performed the statistical analysis, and wrote the manuscript. SR and VF invented REAC technology, collaborated in conceiving the experimental design, wrote the manuscript, and supervised the project. All authors contributed towards data analysis, drafting and critically revising the paper and agree to be accountable for all aspects of the work.

Disclosure

There is a potential competing interest as SR and VF are the inventors of the REAC technology. The authors report no other conflicts of interest in this work.

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