# 120 - EFFECTS OF ESSENTIAL SENSORY-MOTOR INTERVENTION PROGRAM (ISME) IN THE MOTOR REHABILITATION OF PREMATURE NEWBORNS WITH NEUROMOTOR DYSFUNCTIONS

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**Introduction**

The human brain is the master manager of the interactions between the body and its environment. Due to the many areas in the brain associated with motor function, a CNS lesion often interferes negatively in the motor performance of the individual. In high-risk preterm babies it almost always interferes in their neuromotor development, causing the manifestation of the neuromotor dysfunctions. These negative repercussions are manifested through pathological reflexes that generate abnormal postural and movement patterns, which block the normal motor development stage acquisition [2,3,15].

The preterm newborns are at greater risk of presenting neuromotor dysfunctions, due to a greater susceptibility to hypoxic-ischemic syndrome, because of CNS's immaturity. [2,28,29] This population has gradually increased due to the great technological advances of the NICU. These factors contributed to the mortality decrease among this population, thus preserving life; however, it has also increasing the number of high-risk newborns that develop neuromotor dysfunctions. According to American researchers, approximately 25-30% of high-risk preterm newborns develop some sort of neuromotor dysfunction in the first months of life.[17] On the presence of CNS injury the newborns presented the following clinical signs: muscular tone alterations, abnormal motor patterns, persistence of primitive reflexes, and manifestation of pathological tonic reflexes [7,8,24].

Preterm newborns with low birth weight that needed NICU demanded special attention, with regards to their neuro-psycho-motor development, because of their systemic immaturity [31]. Nowadays the attention to those needs is commonly associated with the service programs offered at NICU, which are elaborated based on sensorial and kinetic stimulations, incubator positioning, environmental humanization, respiratory assistance and SLP interventions [5,21,25,26,29,32].

Recently, a clinical study using the application of an Essential Sensory-Motor Intervention (ISME) Program starting immediately after birth, has presented more effective results as related to the motor development of premature newborns with neuromotor dysfunctions.[18,19] This study showed that, in comparison to other studies of more traditional formats where the intervention normally begins after the 3rd or 4th month of life, the early-treated newborns were able to acquire normal neurodevelopment stages in the proper time periods.

Considering the facts hereby presented, this research was proposed with aim to giving support to a hole in a motor physical therapy in the NICU changing the late start of therapy and the non-observance of the sensitive periods of the pre-term newborns. The ISME Program was based on the Neuron-Maturation theory of Behavioral Development, as described by Shepherd.[28] They have defined that the myelination of the spinocerebellar and spinothalamic tracts finished 28th weeks after conception, thus allowing the installation of the automatic adjustment mechanisms, according to the Systems Theory and Dynamic Action Theory. This idea is reinforced by additions of the Neuroscience with respect to brain's plasticity, which shows probable dendrites' (re)organizations in the brain, when stimulation is given during the sensitive periods.[4,6,11]

The start of the ISME Program as from the NICU is also of fundamental importance, if taking into consideration the neurobiology studies, which have shown the plasticity of the nervous system to be an unique characteristic as compared to all other systems. According to Degroot,[30] "the neuronal plasticity is a characteristic of the nervous system that allows the development of structural alterations in response to experiences and the adaptation of the system to changing conditions and repeated stimuli". Without doubt, the "learning process might lead to structural alterations in the brain", as affirmed by Kendall, McGreary and Provance.[23] According to new experimental studies developed with individuals with brain lesions, the neuroscience has proven that the neural network is rearranged, allowing an increasing variety of responses to the environment.[22]

This period corresponds to "windows of opportunity", stating clearly that the more a child is exposed to beneficial stimuli, more she will develop full potential of her brain Gabbard.[20] It suggest that the early start of the intervention, rich in developmental age appropriate stimuli, allows the optimization of the motor development pattern commonly seen in normal children. As stated Chugani[12], *"the first experiences of life are so important that they can change completely the way people develop"*.

Based on the various aspects of the developmental process, it is thought that the ISME Program, if applied before the newborn has experienced and learned the abnormal movements, can contribute as basic element to the formation of new and normal motor patterns.[27] That emanates from the proprioceptive stimuli that form new tracts to the superior centers, according to the "Shunting Law" established by Magnus in 1924 apud B. Bobath.[8] This neural (re) organization is thought to promote the normal motor development in newborns with neuromotor dysfunctions. Chugani[12] adds that: *"the neural fibers capable of activating the brain need to be constructed, and they are, by the demands, the challenges and the stimuli to which a child is subjected, mostly between birth and four years of age"*.

The ISME Program proposes to stimulate the acquisition of posture and movement patterns necessary to the normal motor development of preterms. This study investigated the possibility of normal movement pattern development in premature newborns with neuromotor dysfunctions, by applying the ISME Program immediately after birth and comparing the results to the intervention started at a later stage.

**Method**

Forty preterm newborns from the Hospital Alcides Carneiro, located at the city of Petrópolis, Rio de Janeiro, Brazil, were selected to participate on this study. The continuity of the rehabilitation Program occurred at the Center of Health of Petrópolis, RJ, Brazil. The subjects were divided into two groups: (I.I.G.) immediate intervention group (n=20), who started the ISME Program immediately after birth at the NICU; and (L.I.G) later intervention group (n=20), who started the Program after 11 to 18 months of age (age at which the Program was sought).

The inclusion criteria adopted were: premature newborns below 36 weeks and six days gestation, with Apgar score lower than 6 on the fifth minute, of either sex, with neuromotor dysfunctions at neonatal physical examination[14]. Participated in this study only the pre-term newborns that showed signs of CNS lesion during the neurobehavioral testing, such as: hypertonic

musculature with resistance to passive movement of all extremities, persistence of primitive reflexes, manifestation of pathological tonic reflexes, lack of righting and balance reactions. Newborns with the following signs did not participate in this study: congenital malformations, and epilepsy with difficult to control convulsions, genetic syndromes, cognitive deficits, any type of microcephalus and participation in any other intervention program, as well as the lack of parental consent.

The 40 pre-term stayed on the program during fourteen months between July 1999/July 2002. Population characteristics: mean gestation age of 32.6 (SD = 1.4, range = 30.4 - 36), mean birth weight of 1.555g (SD = 386g, range = 760 - 2.540), considering that 5% had birth weight lower than 1.000g, 55% had birth weight between 1.001 to 1.500g, and 40% had birth weight superior to 1.501g. The mean range of hospitalization time was 41 days (SD = 21 days, range = 18 - 106), and with respect to NB classification, GIG = 5%, AIG = 80% and PIG = 15%. Of those NB, nine were born of caesarian section (45%), and eleven (55%) were born of natural birth.

**Instruments and Procedure**

The diagnostic instruments used in this research for the (I.I.G.) were the following: the Hammersmith Short Neonatal Neurological Examination by Dubowitz et al.[14] the Developmental Reflexes and Reactions Table[13]; the Ballard Table to define the chronological age of the pre-term and the Apgar Scores. As for the selection regarding the cognitive aspects, some topics of the Neurobehavioral Test protocol were used.[14] It is known that premature babies manifest their cognitive potential (competency) particularly through responses to visual, tactile and auditive stimuli.[9,10] For the (L.I.G.) were used: the Evaluation for Muscular Tone by Amiel-Tison associated with the Postural Tone Test from the Bobath concept [31]; the Table of Primitive Reactions and Reflexes and the Denver Motor Developmental Scale.[17]

The intervention instrument used in this study for both groups was the ISME Program, which had as main objectives: a) facilitate the beginning of automatic reactions, at the same time inhibiting pathological motor patterns; b) promote acquisition of the neurodevelopmental stages and the integration of the primitive reflexes. The ISME Program for the (I.I.G.) started at the NICU. There was adopted two sessions a week, of 20 minutes duration, considering the general state of the newborn, monitoring the newborn according to the synactive model approach.[1] After the hospital the program occurred twice a week a mean duration of 30 minutes. The ISME Program for the (L.I.G.) started between the 11$^{th}$ and 18$^{th}$ month of age, when the family or practitioner sought the Program. The program was started with 3 weekly sessions of approximately 40 minutes each for 14 months.

During the application of the program, post-tests were placed according to the following criteria: all were re-evaluated on the 4$^{th}$, 7$^{th}$, 10$^{th}$ and 13$^{th}$ month after starting the Program (these time periods were determined to coincide with the corrected ages of the I.I.G) These evaluations were mainly directed to identify at which stage of the neurodevelopment the newborn was, using as reference the Denver II[32]. To assist in these evaluations, a Child Motor Evaluation Protocol was elaborated, which portrays the motor sequence necessary to acquire the neurodevelopmental stages, from head control until gait. This Protocol consists of the following items: On the 4$^{th}$ month of corrected age: head control, arm support and weight bearing on the legs; On the 7$^{th}$ month of corrected age: trunk control, arm support with extended elbows and weight bearing on the legs; On the 10$^{th}$ month of corrected age: postural transitions and functional use of the arms; and On the 13$^{th}$ month of corrected age: independent gait and integration of the primitive reflexes and reactions. Each item above where the score ranges from 1 to 4.

**Data Analysis**

The statistical study of the results from this research included descriptive analysis and inferences on the data from the periodic evaluations, as related to the motor development of the subjects in each group, scored as above. For the descriptive statistics, the averages and standard deviations of these results were used. For testing of the main hypothesis, a non-parametric statistical instrument was used (Mann/Whitney-test), with a testing reference projected at the value of á < or = to 0.05.

**Results**

According to the Mann/Whitney test results, the hypothesis of no difference between the groups was rejected in all studied variables (Table 1). Both groups considered the results in relation to the motor skill acquisition. The (I.I.G.) showed a superior performance as compared to the (L.I.G.) in all 10 variables of this study.

Table 1: Mann/Whitney Test results for the 4$^{th}$, 7$^{th}$, 10$^{th}$ and 13$^{th}$ month of intervention:

| **4$^{th}$ Month** | **Head Control (Prone)** | **Arm support (Prone)** | **Weight bearing on legs (Placed and held)** |
|---|---|---|---|
| Value-p | 0,01273325 | 0,00409369 | 2,4532 x $10^{-09}$ |
| **7$^{th}$ Month** | **Trunk Control** | **Arm support with extended elbows** | **Weight bearing on legs (Placed and held)** |
| Value-p | 2,6009 x 10-05 | 2,0941 x 10-05 | 6,6358 x 10-09 |
| **10$^{th}$ Month** | **Transitions** | | **Functional use of the arms** |
| Value-p | 4,1432 x $10^{-09}$ | | 4,6223 x $10^{-09}$ |
| **13$^{th}$ Month** | **Independence Gait** | | **Integration of primitive reflexes / reactions** |
| Value-p | 5,496 x 10-09 | | 3,9517 x 10-09 |

To help understand the results of these tests, in (Figure 1) are represented the averages, errors and standard deviations for both intervention groups. There is greater statistical significance on the performance of the (I.I.G.), as opposed to that of the (L.I.G.). Special attention must be given to the variables I10, II10; I13 and II13, where there was 100% performance achievement by the subjects of the (I.I.G.), thus confirming the hypothesis of this study.

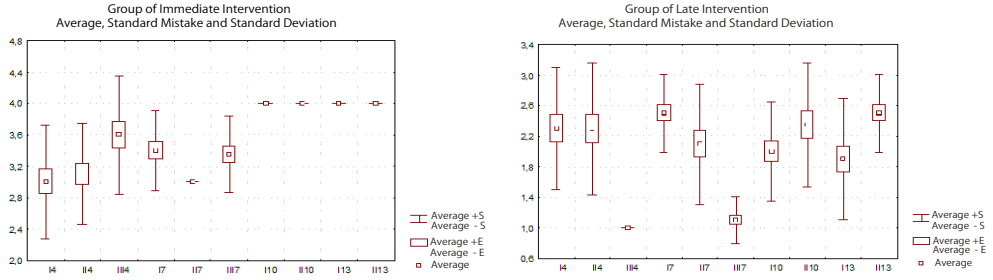


Figure 1: Averages, variations and standard deviations of the motor development acquisition of I.I.G. and L.I.G. of the all variables studied.

According to the results obtained on the evaluations on the 10th and 13th months, subjects from the (I.I.G.) have reached their maximum score (4, 0) on the four studied motor-stage variables related to corrected age (figure 1). This means that 100% of the babies who started the program immediately after birth, acquired all the motor stages related to their corrected age, according to the Denver Scale II.

**Discussion**

Based on these results, it was observed that the ISME Program has efficiently facilitated the motor development stage acquisition and therefore, has optimized the motor-function learning process of the (I.I.G.). Thus, it is questionable whether similar results could be obtained with the (L.I.G.), if immediate treatment had been applied to this group.

This study suggests that it is possible to avoid what the premature newborns with neuromotor dysfunctions to have automatizing abnormal movements. It has also been shown that children, who started with the immediate intervention after birth, have developed independent gait at approximately the 13th month of corrected age.

Comparing the results between the two groups, those who received the immediate intervention achieved maximum scores from the 10th month of the Program and of corrected age. On the contrast newborns of later intervention have maintained the average score between 1.0 e 2.6, not achieving independent gait and showing persistence of primitive reflexes and reactions. After 14 months of ISME intervention, 35% of that group could roll, pass actively to sitting and maintain the posture; 40% could roll, pass to sitting and four point; and 25% could crawl, pass to standing position with support, but could not maintain standing without support.

It is supposed that the unsatisfactory results of the L.I.G. may have been caused by the diagnostic lateness. Therefore, this group initiated treatment later, which could have permitted the installation of pathological patterns. This brings up a thought about the necessity of a physical exam protocol, of easy application and interpretation, which could indicate the first signs of CNS lesions, thus allowing health professionals to quickly guide these children to intervention programs.

Based on DeGroot[30] and Chugani[12] studies it could be affirmed that once the ISME program have started before newborns have achieved 40 weeks of age, it is possible and necessary to interfere right after birth, as soon as the neurological signs are identified.[14] It suggests as well, that the neural plasticity of the baby is very rich as related to the amplification of the dendritic tree.

The limitations of this study are related to the great difficulty encountered in the Brazilian public services in accessing high-resolution tests, such as Functional MRI and the Trans-fontanel Ultrasound.

**Conclusions**

The results of this study showed that immediate intervention using the **ISME** Program, promoted total rehabilitation of the motor patterns (head control, sitting, crawling and gait) in preterm babies who presented with lesions to their CNS. The implementation of the **ISME** Program starting in the NICU optimized the conditions for the integration of primitive reflexes, total inhibition of spasticity and inhibition of pathological reflexes, thus allowing for the learning of new motor patterns necessary to the acquisition of the appropriate motor developmental stages. Examination of the available literature showed that this model of immediate intervention had not yet been experimented. Although there is plenty literature about early intervention in the NICU, none of the programs envisaged a therapy which required an active response from the preterm newborn to the intervention.

Based on found results and through comparison with Denver II Scale, related to the acquisition of motor development stages, it could be said that the damaged brain is also capable of learning new motor skills, once pathological patterns haven't yet been installed. The functional alterations become possible due to the neural plasticity of the newborn and appropriate stimulation at the proper time. By starting the **ISME** program as soon as possible, the neuromotor system has not yet experienced the pathological movements, therefore has not yet created a motor plan for it. And, through the expansion of the dendritic tree, stimulated by the Essential Sensory-Motor exercises, new motor programs are created, promoting the achievement of the appropriate motor-developmental stages.

Based on the above, it is suggested that the **ISME** Program would be of value starting as from the NICU, even when the neuromotor dysfunctions are suspected to be only of temporary nature.

Comparing the effects of the ISME Program between the G.I.I and G.L.I., it is clear that the early start of the intervention, and the requirement for active responses from the newborn, were of fundamental importance in the normalization of the motor patterns and for the acquisition of the motor developmental stages in the proper time period.

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**EFFECTS OF ESSENTIAL SENSORY-MOTOR INTERVENTION PROGRAM (ISME) IN THE MOTOR REHABILITATION OF PREMATURE NEWBORNS WITH NEUROMOTOR DYSFUNCTIONS**

**ABSTRACT**

Introduction: Thirty percent of premature newborns that need special care and who undergo NICU are at risk of developing brain injuries. Purpose: This study investigated the effects of an immediate intervention program compared to the effects of the same program applied at a later stage, in premature newborns with neuromotor dysfunctions due to hypoxic-ischemic syndrome. The Denver II scale provided the referential points for analysis of the neurodevelopment motor stage gains achieved with the ISME program. Methods: Forty preterm babies presented signs of Central Nervous System lesions at the Dubowitz tests. The subjects were divided into two groups: the immediate intervention (n=20), and the later intervention (n=20). The pre and post program data were studied through qualitative analysis and non-parametric statistics (Mann/Whitney test), considering the acquired motor stages. Variance analysis revealed a significant statistical difference between data from both groups in all trimesters of the program's application, with $p<0.05$ for all considered variables. Results: the first group (of immediate intervention) revealed 100% success in terms of regaining motor normality, showing, at 13 months of corrected age, active gait with normal pattern of posture (static and dynamic) and normal postural reflex mechanisms. The second group, of later intervention, did show a decrease of the abnormal motor patterns and the pathological reflexes. However, after 14 months of intervention, 35% was able to roll, to pass actively to sitting and maintain the position; 40% was able to roll, transition to sitting and four-point; and 25% was able to crawl, transition to standing with support, but was unable to maintain independent stance. Conclusion: The results support the utmost importance of the early application of the I.S.M.E. program starting at the NICU, to promote better results on the motor rehabilitation of newborns with neuromotor dysfunctions, rather then later.

KEY WORDS: Prematurity, Hypoxic-Ischemic Syndrome, Early Intervention Program.

**EFFETS DE LA PHYSIOTHÉRAPIE NEUROFONCTIONNELLE DEPUIS L' U.T.I. (UNITÉ DE THÉRAPIE INTENSIVE) NÉO-NATALE DANS LA RÉCUPERATION DE LA MOTRICITÉ DE BEBÉS PRÉMATURÉS PORTEURS DE TROUBLES FONCTIONNELS DE NEUROMOTRICITÉ.**

**RÉSUMÉ**

Introduction : Trente pourcents des bebés nés prématurément qui nécessitent de soins spéciaux et se destinent a l' Unité de Thérapie Intensive Néo-natale sont sujets au risque de souffrir des dommages cérébraux. Objet: La présent étude a décrit les effets d'un programme d'intervention immédiate lorsqu'ils sont comparés avec ceux du même programme, mais d'intervention tardive, en bebés porteurs de troubles fonctionnels de neuromotricité avec un historique de syndrome hypóxie-

ischémique. Les points référentiels pour analyse sur avantages provenant des interventions ont constitué les étapes neuro-évolutives du développement moteur du bebé de l'Escale de Denver II. Méthodologie: Ont participé de cette étude 40 pré-termes, lesquels dans le test de Dubowitz, ont presenté des signes indicatifs de lésion centrale. Les donnés obtenues lors de l'entrée et post-programme ont été traîtées moyennant analyse non-paramétrique (Mann/Whitney test), ayant comme références les acquisitions de motricité apprises. L'analyse de variation a révélé une signification statistique entre les données des deux groupes pendant tous les trimestres d'application du programme, soit $p<0.05$ en toutes les variations étudiées.Résultat: Les donnés en termes de récomposition de la normalité motrice du premier groupe, ont révélé que tous les nouveaux-nés du groupe d'intervention immédiate, à 13 mois d'âge corrigé, ont présenté une marche active avec des normes de posture statique et dynamique automatique. Le deuxième groupe, celui de l'intervention tardive, a présenté diminution de normes motrices anormales et diminution des reflets pathologiques, cependant, lors de l'évaluation aprés intervention, 35% du groupe roulait, passait activement à la position assise et restait dans la position ; 40% roulaient, passaient à la position assise et à chattes ; et 25% se traînaient à quatre pattes, passaient à debout avec appui, mais ne se maintenaient pas debouts, sans appui. Conclusion: Ces résultats ont été discutés, fournissant un support au sujet de l'importance de l'application du programme de l'intervention sensorielle-motrice essentielle (I.S.M.E.) depuis l'U.T.I. néo-natale, pour l'obtention de resultats positifs dans la récupération motrice de bebés porteurs de troubles fonctionnels de neuromotricité.

MOTS-CLES: prématurité, programme interventionnel, trouble fonctionnel de neuromotricité.

**EFECTOS DE LA FISIOTERAPIA NEUROFUNCIONAL DESDE LA UTIN EN LA RECUPERACION MOTORA DE BEBÉS PREMATUROS CON DISFUNCIONES NEUROMOTORAS.**

**RESUMEN**

Introducción: Treinta por ciento de los bebés nacidos prematuramente que necesitan cuidados especiales y van para la Unidad de Terapia Intensiva Neonatal tienen riesgo de sufrir daños cerebrales. Objetivo: El estudio describe los efectos de un programa de intervención inmediata en comparación con los observados con intervención tardía, en bebés con disfunciones neuromotoras. Los puntos de referencia para analizar las ventajas provenientes de las intervenciones fueron las etapas neuroevolucionadas del desarrollo motor del bebé en la Escala de Denver II. Metodología: Participaron del estudio 40 prematuros que presentaban señales indicadoras de lesion central en el test de Dubowitz. Los datos obtenidos al comienzo y post-programa fueron tratados en un análisis no paramétrico (Mann/ Whitney Test), teniendo como referencia las adquisiciones motoras aprendidas. El análisis de variancia revelo una estadística significativa entre los datos de los dos grupos en todos los trimestres de la aplicación del programa, siendo $p<0,05$ en todas las variables estudiadas. Resultados: Los datos referentes a la recomposición de la normalidad motriz del primer grupo revelaron que todos los recién-nacidos del grupo a los 13 meses de edad corregida, presentaron marcha activa con patrones de postura estática y dinamica normal, con mecanismo de reajuste automático. El segundo grupo, de intervención tardia mostro disminución de los patrones motores anormales y disminución de los reflejos patológicos. Sin embargo, en la evaluación, después de la intervención, 35% del grupo rodaba, pasaba activamente a la posición sentado y permanecia en esa posición. 40% rodaban, pasaban a la posición sentado y luego a la de gato y 25% gateaba y pasaba a la posición de pie con apoyo, pero no se mantenía de pie sin apoyo. Conclusión: Estos resultados fueron discutidos, ofreciendo soporte para la importancia de la aplicación del programa de intervención sensitiva-motora esencial (I.S.M.E) desde la UTIN para la obtención de resultados positivos en la recuperación motriz de bebés con disfunciones neuromotoras.

PALABRAS CLAVE: prematuridad, programa de intervención, disfunción neuromotora.

**EFEITOS DO PROGRAMA DE INTERVENÇÃO SENSÓRIO-MOTORA ESSENCIAL (ISME) DESDE A UTIN, NA RECUPERAÇÃO MOTORA DE BEBÊS PREMATUROS COM DISFUNÇÕES NEUROMOTORAS.**

**RESUMO**

Introdução: Trinta por cento dos bebês nascidos prematuramente que necessitam de cuidados especiais e vão para Unidade de Terapia Intensiva Neonatal são de risco a sofrerem injurias cerebrais Objetivo: O presente estudo descreveu os efeitos de um programa de intervenção imediata quando comparados com os efeitos do mesmo programa, porém, de intervenção tardia, em bebês portadores de disfunções neuromotoras com história de síndrome hipóxico-isquêmica. Os pontos referenciais para análise sobre ganhos advindos das intervenções foram às etapas neuroevolutivas do desenvolvimento motor do bebê da Escala de Denver II. Metodologia: Participaram deste estudo 40 pré-termos que, no teste de Dubowitz, apresentaram sinais indicativos de lesão central. Os dados obtidos na entrada e pós-programa foram tratados através de analise não paramétrica (Mann/Whitney test), tendo como referência as aquisições motoras aprendidas. A análise de variância revelou significância estatística entre os dados dos dois grupos em todos os trimestres da aplicação do programa, sendo $p<0.05$ em todas as variáveis estudas. Resultados: Os dados em termos da recomposição da normalidade motriz, do primeiro grupo, revelaram que todos os recém-natos do grupo de intervenção imediata, aos 13 meses de idade corrigida, apresentaram marcha ativa com padrões de postura estática e dinâmica normal, com mecanismo de reajuste automático. O segundo grupo, o de intervenção tardia, mostrou diminuição dos padrões motores anormais e diminuição dos reflexos patológicos, porém, na avaliação, após intervenção, 35% do grupo rolavam, passavam ativamente para sentado e permaneciam na postura; 40% rolavam, passavam para sentado e para gatas; e 25% engatinhavam, passavam para de pé com apoio, porém não se mantinha de pé se apoio. Conclusão: Estes resultados foram discutidos, fornecendo suporte sobre a importância da aplicação do programa de intervenção sensório-motora essencial (I.S.M.E.) desde a UTI neonatal para a obtenção de resultados positivos na recuperação motriz de bebês portadores de disfunções neuromotoras.

PALAVRAS-CHAVE: Prematuridade, programa intervencional, disfunção neuromotora.