

Original Article

Effects of Sensory-Motor Stimulation by the Padovan® Method on Weight Gain in Premature Infants Weighing Less than 1,500g

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Abstract: An observational analytical retrospective study was conducted to assess the efficacy of the Padovan® Method in promoting weight gain in very low birth weight premature infants. The study took place at a hospital and maternity ward in the Cariri region between 2020 and 2023. The sample included premature infants weighing less than 1500g admitted to the Neonatal Intensive Care Unit. Data were correlated with the scientific literature using descriptors such as “early stimulation,” “sensory-motor stimulation,” “very low birth weight,” and “premature infant”. The study involved 34 premature infants with gestational ages between 25 and 34 weeks and 5 days, all with very low birth weight and hemodynamically stable. These patients received a minimum fluid intake of 180 mL/kg/day for at least 14 days without sensory-motor stimulation. After this period, the Padovan® Method was applied until hospital discharge or until the newborns reached 1700g. A comparative analysis of weight gain before and after the application of the method revealed that 82.3% of the patients showed significant weight gain, while 17.6% did not show significant changes. The Padovan® Method may be an effective tool for promoting weight gain in premature infants, contributing to faster clinical improvement and reduced hospitalization time.

Keywords: Very Low Birth Weight Newborn; Premature Infants; Weight Gain; Early Stimulation; Sensory-Motor Performance; Neonatal Care; Tactile-Kinesthetic Stimulation.

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1. Introduction

Preterm birth, defined as delivery before 37 weeks of gestation, carries significant implications for neonatal health. Babies born prematurely face higher susceptibility to health complications compared to those born at term. Among the most common adversities associated with this condition are respiratory disorders, visual impairments, hearing deficiencies, and challenges in neurological development. Various factors converge to trigger preterm birth, including maternal infections, gestational illnesses, placental disorders, as well as adverse behaviors such as smoking, alcohol, and drug use, and the impact of stress [1, 2].

Preterm infants with very low birth weight (<1500g) require special care to promote healthy growth and development. Weight gain is a crucial predictor of neurodevelop-

mental outcomes in these babies, and early weight gain is associated with better neuro-developmental outcomes in preterm infants [3]. The American Academy of Pediatrics recommends a minimum weight gain of 15 to 20 grams per day in the first weeks of life [4]. However, factors such as gestational age, birth weight, and length of stay in the neonatal intensive care unit (NICU) can influence this gain [5].

Sensory-motor stimulation techniques, including massage and multimodal tactile-kinesthetic stimulation, have been shown to improve weight gain and sucking in preterm newborns. According to the First Brazilian Recommendation of Physiotherapy for Sensory-Motor Stimulation of Newborns and Infants in the NICU, these techniques can be beneficial [6].

The Padovan Method, developed by Beatriz Padovan in the early 1970s, represents a rehabilitation approach based on the concept of neural plasticity. This method employs a series of carefully designed exercises to stimulate various brain regions and components of the peripheral nervous system, aiming to reinforce ontogenetic development from conception to adulthood. Since 2008, this technique has been used in a neonatal ICU in the interior of Ceará State, showing efficacy in various neurological conditions, including cerebral palsy, various syndromes, sequelae post-stroke, and developmental delays [7-13].

The Padovan Method has proven to be an effective sensory-motor stimulation technique, with benefits in improving motor function and cognitive skills in individuals, and can be adapted to the specific needs of each patient, making it a personalized and effective rehabilitation approach [15, 16]. Recent research highlights the value of the method as an early stimulation approach in neonatal intensive care units, as well as its role in neonatal neurological recovery, showing its potential benefits in various contexts [9, 14, 15]. According to the recommendations of the Physiotherapy Department of the Brazilian Intensive Medicine Association (AMIB), tactile-kinesthetic stimulation can improve weight gain and sucking in preterm infants. Therefore, the Padovan® Method, as a multimodal sensory-motor stimulation technique already used in the aforementioned ICU in Ceará, can be an effective intervention in aiding weight gain in preterm newborns [6].

Thus, the objective of this study was to verify weight gain in preterm infants weighing less than 1,500g subjected to sensory-motor stimulation using the Padovan® Method.

2. Method

This is an observational, analytical, and retrospective study aimed at verifying weight gain in preterm infants weighing less than 1,500g subjected to sensory-motor stimulation with the Padovan® Method. The study was conducted using data from patient records at the Hospital and Maternity in the Cariri region, from 2020 to 2023. It is part of a research project titled "Research Project on the Efficacy of the Padovan Method of Neurofunctional Reorganization in Neurological Patients," approved by the CEP under number 1.308.202, CAAE 49187615.5.0000.5038.

2.1. Inclusion Criteria

Premature infants weighing less than 1,500g, without sepsis and hemodynamic disturbances, admitted to the Neonatal Intensive Care Unit were included. Participants had individual daily weight gain records for at least 15 days after the start of full diet (QH = 180ml/kg/day) and after the start of sensory-motor stimulation with the Padovan® method, until discharge or until they reached a minimum weight of 1,700g.

2.2. Application of the Padovan Method

The technique was applied by a physiotherapist qualified in the method, once a day, five days a week, performing the same exercises for all infants, with a total therapy duration of 30 minutes, including the following exercises:

- Motor Exercises: Movements typical of human development that stimulate touch, proprioception, and the vestibular system; flexion and extension of arms and legs, head rotation, standardization of posture in the prone position, half-rolling.
- Respiratory Exercises: Nasal and oral blows stimulating the olfactory nerve, diaphragm, and larynx.
- Photomotor Exercises: Use of a flashlight with yellow light, positioned 30 cm from the face.
- Orofacial Exercises: Vibration with a vibrating massager on the entire face and intraoral area; exercises with elastic bands on the tongue and passive suction.

2.3. Data Collection and Analysis

Statistical analyses were performed using SPSS version 25. Data were expressed as measures of central tendency and dispersion. Normality of the data was tested using the Kolmogorov-Smirnov test. The comparison between mean weight gain before and after therapy was evaluated using the Wilcoxon test, due to the non-normality of the data. Data were considered significant with p-values below 0.05.

The test power was evaluated post hoc using G*Power software version 3.1. For a sample of 34 participants, an effect size of 0.5, and an α error of 0.05 with a non-centrality parameter δ of 2.92, a critical t of 1.69, and a degree of freedom of 33, the post hoc calculated power for the comparison of two related means of weight gain before and after therapy was 88.68%. Therefore, the statistical power indicated that the sample size was adequate for its purpose, and the statistical analysis for comparing weight gain means before and after therapy was robust enough to detect the difference between the investigated periods.

2.4. Theoretical Foundation

To correlate the results obtained with the scientific literature, a search for articles from journals and periodicals was conducted through the Virtual Health Library, using databases such as PubMed, Scielo, and LILACS. The following descriptors were used: "early stimulation," "sensory-motor stimulation," "very low birth weight," "premature," "neonatal care," and "tactile-kinesthetic stimulation." Complete articles were included if, after reading the abstract, they addressed the proposed objective. Monographs and theses were excluded.

3. Results

During the period from January 2020 to September 2023, 34 preterm infants were included with gestational ages ranging from 25 weeks to 34 weeks and 5 days, with a median of 29 weeks. Birth weights ranged from 754g to 1485g, with a median of 1124g (Table 1).

Table 1. Central Tendency and Dispersion Measures of Variables: Gestational Age, Birth Weight, Number of Days Before Therapy, Weight at the Start of Therapy, and Weight Gain Before and After Therapy for Preterm Infants.

Variables	n	Minimum	Maximum	Mean	Standard Deviation	Confidence Interval Minimum	Confidence Interval Maximum	Median	Interquartile Range
Gestational Age (weeks)	34	25.00	34.71	29.25	2.44	28.40	30.10	29.00	3.64
Birth Weight (g)	34	754.00	1485.00	1146.85	210.05	1073.56	1220.14	1124.00	383.50
Number of	34	11.00	55.00	22.68	9.88	19.23	26.12	21.00	13.00

Days Before Therapy									
Weight at the Start of Therapy (g)	34	880.00	1680.00	1321.18	223.09	1243.34	1399.02	1330.00	347.50
Number of Days of Therapy	34	6.00	71.00	26.12	15.55	20.69	31.54	23.50	23.75
Weight Gain Before Therapy (g/day)	34	3.20	29.20	15.51*	6.33	13.30	17.71	15.70	7.53
Weight Gain After Therapy (g/day)	34	8.90	42.70	25.46*	8.28	22.58	28.35	23.20	14.20

Legend: *Comparison of weight gain before and after therapy according to the Wilcoxon test, with $p < 0.001$. A p-value below 0.05 was considered significant.

Once the patients were hemodynamically stable, free of sepsis, and on a diet with a fluid quota of 180 mL/kg/day, their weight gain without sensory-motor stimulation was recorded over a minimum period of 14 days, ranging from 11 to 55 days without therapy (median of 21 days). The weight gain ranged from 3.2g/day to 29.2g/day, with a median of 15.7g/day.

After this period, sensory-motor stimulation with the Padovan® Method was initiated until the patient's discharge, when they reached a weight of 1700g or more, received their entire diet orally, and maintained their weight gain. The analysis of daily weight gain during the stimulation period, which ranged from 6 to 71 days (median of 23.5 days), showed that weight gain with the Padovan® Method varied from 8.9g/day to 42.7g/day (median of 23.2g/day). Among the patients, 28 (82.3%) gained more weight after starting therapy, while 6 (17.6%) did not show an increase in weight gain (Table 1).

The weight at the start of therapy ranged from 880g to 1680g (median of 1330g), and all patients weighing less than 1000g gained more weight with the therapy than during the period without stimulation (Table 1).

4. Discussion

The recovery of preterm infants faces many challenges until hospital discharge. Even after overcoming major respiratory, infectious, and metabolic complications, they still need a few more days of hospitalization to reach the appropriate weight for discharge. Extremely preterm infants are increasingly surviving but with outcomes related to neurodevelopment, such as cerebral palsy and cognitive deficits, as well as Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder, and epilepsy [2, 6, 15, 16].

In 2021, the First Brazilian Recommendation for Sensory-Motor Stimulation for Newborns and Infants in Intensive Care Units was published, following a systematic review of the literature from 2010 to 2018. The studies were analyzed and discussed with specialists at Brazilian congresses, concluding that sensory-motor stimulation modalities with a high degree of scientific certainty were skin-to-skin stimulation, followed by multisensory stimulation. Therapeutic massage, tactile-kinesthetic stimulation, and multisensory stimulation were shown to improve weight gain and sucking [6].

Intrauterine, the fetus develops sensory-motor functions in a sequence: tactile first, followed by vestibular, gustatory, olfactory, auditory, and visual systems. In the NICU environment, this sequence is disrupted by painful tactile stimuli, excessive auditory and visual stimuli, and deprivation of vestibular, gustatory, and olfactory stimuli, potentially leading to sensory losses and compromising cortical development, particularly of the sensory-motor cortex [15, 16].

The main objective of sensory-motor stimulation (SMS) is to provide stimuli to the body's systems — tactile, kinesthetic, vestibular, olfactory, gustatory, auditory, and visual. When used individually, these are called unimodal stimulation, and when combined, they are called multimodal stimulation (tactile-kinesthetic and skin-to-skin contact). These stimuli help reduce stress, pain, heart and respiratory rates, regulate sleep stages, improve tone, strength, bone mineralization, and pondero-statural gain [15, 16].

In the service where this study was conducted, the Padovan® Method has already been used for neurological recovery of newborns, with published results showing improved sucking in asphyxiated and syndromic patients and results for apnea of prematurity [8-13]. The Padovan® Method fits into the multisensory modality, as its exercises include movements of neurodevelopmental motor patterns, vestibular, visual, auditory, respiratory, tactile, and proprioceptive stimuli [11], aligning with Brazilian Physiotherapy recommendations.

It is essential that preterm infants, especially those at risk for neurodevelopmental delays, receive sensory-motor stimulation to contribute to their neurological maturation while reaching the weight for discharge [6-10]. Initially, neonatologists were concerned that these techniques might increase caloric expenditure and compromise weight gain. However, several studies have shown that tactile-kinesthetic stimulation increases weight gain, reducing hospitalization time. Studies have demonstrated that techniques using movements have better outcomes in weight gain compared to those using only massage, and also contribute to improved sucking and reduced apnea episodes [6-10], justifying the use of the Padovan® technique for neurological recovery of preterm infants and accelerating weight gain. This is crucial, as neurological delays and insufficient weight for discharge are events responsible for the prolonged stay of preterm infants in neonatal units [6].

Studies analyzing sensory-motor stimulation techniques using the Padovan® Method in newborns evaluated gestational ages above 28 weeks [8-10, 15]. However, our study evaluated very low birth weight preterm infants (<1500g), with gestational ages ranging from 25 weeks to 34 weeks and 5 days. Despite this, weight gain increased (82.3%), with all patients born weighing less than 1000g gaining more weight during therapy than during the period without stimulation, confirming the benefits of tactile-kinesthetic stimulation as seen in the literature [6, 8-10, 15].

Litmanovitz et al. analyzed three groups of very low birth weight (<1500g) newborns with passive extension and flexion stimulation of the upper and lower limbs. One group received no stimulation, one group received stimulation once a day, and the third group received stimulation twice a day. The group that received stimulation twice a day showed a decrease in bone resistance and a reduced risk of osteopenia [17].

A systematic review in 2021, with 16 relevant clinical trials, analyzed studies using tactile and kinesthetic stimulation in preterm newborns from 26 to 32 weeks, weighing 900g to 1900g. The bone density measures were analyzed using plasma and urinary biomarkers, bone ultrasound, and densitometry, as well as anthropometric measures. It was found that daily passive mobilization with gentle joint pressure for 10 to 15 minutes per day for 4 to 8 weeks is the intervention that most benefits bone mineralization and weight gain [18]. Similarly, a randomized, controlled, double-blind experimental study with a daily exercise program in 2020 showed a positive effect on tibial speed of sound (SOS) values for bone mineral density and reduced serum cortisol in preterm infants, also demonstrating anti-stress effects [1].

This study did not include a control group because all preterm infants during the period were subjected to the Padovan® Method. Each infant was compared to themselves, as it has been routine in the service for 15 years to use the technique for rehabilitation. For preterm infants, it was initiated after a period of hemodynamic stability and receiving a fluid quota of more than 180 mL/kg/day, without any pathology. Our objective was to analyze and publish what we observed in daily practice, the increase in weight gain concomitant with neurological recovery, since it is a multimodal stimulation, also stimulating the tactile, kinesthetic, olfactory, gustatory, balance, auditory, and visual systems.

Although we have used the technique for 15 years, the sample size was small because only from 2020 did the team start applying stimulation to preterm infants weighing less than 1500g, following contemporary publications on the benefits and non-maleficence for weight gain. Another limiting factor for more studies using the technique is that it is still relatively unknown among healthcare professionals. The service where this study was conducted is the only one in the world to have used the method for a long time. However, several Padovan therapists have been trained in Brazil and some European countries, but they still do not have access to ICUs. Recently, physiotherapy teams from two other hospitals in the State of Ceará received training in the technique and have started using it, possibly leading to the publication of their results soon to verify the method's generalization capacity.

No studies have reported a standardized technique, and tactile-kinesthetic and skin-to-skin stimulation have shown the most benefits in sensory-motor development, bone mineralization, and weight gain [6, 16-20]. Our study can contribute to a complete multimodal technique that, while providing early stimulation and minimizing neurodevelopmental sequelae, can also accelerate weight gain and reduce hospitalization time.

5. Conclusion

The Padovan® Method is a sensory-motor stimulation technique that has shown efficacy in the neurological recovery of term and preterm newborns. This study demonstrated that the method can also be used to accelerate weight gain and shorten hospital stays. As a multisensory technique, its dissemination should be encouraged to train more professionals and develop more studies to contribute to the literature. Additionally, more studies in other centers with control groups and larger sample sizes are necessary to strengthen the literature and confirm the observed benefits, expanding the use of the technique in neonatal intensive care units.

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References

1. Ministério da Saúde. Manual de Gestaç o de Alto Risco. Bras lia, DF: [s.n.]; 2022. Vers o preliminar.
2. World Health Organization. Preterm Birth. 2023.
3. Macedo I, Pereira-Da-Silva L, Brito L, Cardoso M. Male sex is an independent risk factor for poor neurodevelopmental outcome at 20 months' corrected age in human milk-fed very preterm infants: a cohort study. **Einstein (S o Paulo)**. 2019;17(3):eao4607.
4. American Academy of Pediatrics. Nutritional needs of the preterm infant. In: *Pediatric Nutrition*. Itasca, IL: American Academy of Pediatrics; 2020.

5. Carvalho RMD, Oliveira MAS. Baixo peso ao nascer associado a fatores de risco maternos e neonatais. **Rev Sustinere**. 2023;11(1).
6. Johnston C, Stopiglia MC, Ribeiro SNS, Baez. Reply to: First Brazilian recommendation on physiotherapy with sensory motor stimulation in newborns and infants in the intensive care unit. **Rev Bras Ter Intensiva**. 2022;34(2).
7. Padovan BAE. Reorganização neurológica (Método Padovan). **Temas Sobre Desenvolvimento**. 1994;3(17):13-21.
8. Delmondes EDL, Albuquerque LTC, Pereira LM. Neurorehabilitation with Padovan method in a newborn with Treacher Collins syndrome: a case report. **Amadeus Int Multidiscip J**. 2018;3(5):1-7.
9. Medeiros Pereira L, Correa Vileicar D, Bezerra Sales S, et al. Padovan method of neurofunctional reorganization as a way for neurological recovery in newborns. **Int Arch Med**. 2015.
10. Pereira LM, Vileicar DC, Uchôa MMA. Neuroreabilitação com o Método Padovan® em recém-nascidos com síndrome alcoólica fetal: relato de 2 casos. **J Health Biol Sci**. 2018;6(2):214-216.
11. Pereira ., Frota Aragão ., Mesquita Ponte ., Silva Alencar ., Lucas Romão . Relação entre a integração sensorial e o Método Padovan®. **Rev Saúde Multidiscip**. 2021;10(2).
12. De Freitas IRG, Delmondes EDL, Albuquerque LTC, Maciels BS, Silva MJDL, Pereira LM. O método Padovan® como coadjuvante à cirurgia de alongamento dos tendões em crianças com paralisia cerebral: dois relatos de caso. **Rev Eletr Acervo Saúde**. 2020;57:e3375.
13. Farias J de O, Moreira AB, Pereira LM, Maciel SBS. Neuroreabilitação com o Método Padovan® em recém-nascidos com paralisia facial congênita: relato de 2 casos. **Amadeus Int Multidiscip J**. 2022;6(12):1-21.
14. Da Silva Neto JR, Picanço KRT, Moreira YP, Andrade AC, Oliveira CA, Almeida ANF. Efeito do Método Padovan em ambientes clínicos: uma revisão da literatura. **Cad Educ Saúde Fisioter**. 2016;3(6).
15. Vogel D, Ostermann T, Vogel H, Loskamp K, Fetz K. Recommendation of neurorehabilitation according to the Padovan-method neurofunctional reorganization® for treating neurodevelopmental disorders: a systematic review. **Complementary Med Res**. 2022;29(4):330-361.
16. Johnston C, Nicolau CM. Estimulação sensório-motora em recém-nascidos pré-termo extremo na unidade de terapia intensiva de neonatal. In: Sociedade Brasileira de Pediatria; Procianny RS, Leone CR, organizadores. **PRORN Programa de Atualização em Neonatologia: Ciclo 17**. Porto Alegre: Artmed Panamericana; 2020. p. 89–120. (Sistema de Educação Continuada a Distância, v. 2).
17. Litmanovitz I, Erez H, Eliakim A, Bauer-Rusek S, Arnon S, Regev RH, Sirota G, Nemet D. The effect of assisted exercise frequency on bone strength in very low birth weight preterm infants: a randomized control trial. **Calcif Tissue Int**. 2016 Sep;99(3):237-42. doi: 10.1007/s00223-016-0145-3. Epub 2016 May 3. PMID: 27142078.
18. Torró-Ferrero G, Fernández-Rego FJ, Gómez-Conesa A. Physical therapy to prevent osteopenia in preterm infants: a systematic review. **Children (Basel)**. 2021 Jul 30;8(8):664. doi: 10.3390/children8080664. PMID: 34438555; PMCID: PMC8391284.
19. Sezer Efe Y, Erdem E, Güneş T. The effect of daily exercise program on bone mineral density and cortisol level in preterm infants with very low birth weight: a randomized controlled trial. **J Pediatr Nurs**. 2020 Mar-Apr;51:e6-e12. doi: 10.1016/j.pedn.2019.05.021. Epub 2019 Jul 6. PMID: 31285069.