

Physiotherapists' perception of changes in the autonomic system and behavioral state of newborns undergoing sensory motor stimulation procedures: cross-sectional study

Percepção de fisioterapeutas sobre alterações do sistema autônomo e do estado comportamental de recém-nascidos submetidos a procedimentos de estimulação sensório-motora: estudo transversal

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ABSTRACT | INTRODUCTION: Sensory motor stimulation (SMS) is an early intervention used in newborns (NB) to organize their systems. The physiotherapist who uses SMS must pay careful attention to the signs presented by NB after the procedures. **OBJECTIVE:** To analyze the perception of physiotherapists about changes in the autonomic system and behavioral state of NB after SMS procedures. **METHODS:** Cross-sectional study carried out with physiotherapists working in neonatal units. Data were collected by electronic questionnaire, processed in the SPSS program (version 21.0) and presented in absolute (n) and relative (%) frequency. **RESULTS:** 72 physiotherapists participated in this study, 48.6% had a specialist degree, 63.9% worked in Neonatal Intensive Care Unit, 38.8% lived in the southern region and 38.8% in the southeastern region of Brazil. The perception of most physiotherapists after tactile procedures was stability or decrease in heart rate (HR), respiratory rate (RR) and stability of oxygen saturation (SpO₂), and after vestibular procedures it was stability of HR, RR and SpO₂. There was a perception of active sleep, drowsiness, and active alertness after all tactile and vestibular procedures. Active alertness was noticed after all procedures and intense crying was not noticed. **CONCLUSION:** Regarding the autonomic system, most physiotherapists noticed stable or decreased HR and RR, and stable or increased SpO₂ after SMS procedures. Regarding the behavioral state, active alert was noticed more frequently among physiotherapists.

KEYWORDS: Neonatal Intensive Care Unit. Sensory Motor Stimulation. Newborns. Physical Therapists. Synactive Theory of Development.

RESUMO | INTRODUÇÃO: A estimulação sensório-motora (ESM) é uma intervenção precoce utilizada em recém-nascidos (RN) para a organização de seus sistemas. O fisioterapeuta que faz uso da ESM deve ter um olhar cuidadoso para os sinais apresentados pelos RN após os procedimentos. **OBJETIVO:** Analisar a percepção de fisioterapeutas sobre alterações do sistema autônomo e do estado comportamental de RN após procedimentos de ESM. **MÉTODOS:** Estudo transversal realizado com fisioterapeutas atuantes em unidades neonatais. Os dados foram coletados por questionário eletrônico, processados no programa SPSS (versão 21.0) e apresentados em frequência absoluta (n) e relativa (%). **RESULTADOS:** Participaram deste estudo 72 fisioterapeutas; 48,6% possuíam título de especialista, 63,9% atuavam em Unidade de Terapia Intensiva Neonatal, 38,8% residiam na região sul e 38,8% na região sudeste do Brasil. A percepção da maioria dos fisioterapeutas após procedimentos de ordem tátil foi estabilidade ou diminuição da frequência cardíaca (FC) e respiratória (FR), e estabilidade da saturação de oxigênio (SpO₂), e após procedimentos de ordem vestibular foi estabilidade da FC, FR e SpO₂. Houve percepção de sono ativo, sonolência e alerta ativo após todos os procedimentos de ordem tátil e vestibular. O alerta ativo foi percebido após todos os procedimentos e o choro intenso não foi percebido. **CONCLUSÃO:** Do sistema autônomo, a maioria dos fisioterapeutas perceberam a FC e FR estáveis ou diminuídas e SpO₂ estável ou aumentada após os procedimentos de ESM. Do estado comportamental, o alerta ativo foi percebido com maior frequência entre os fisioterapeutas.

PALAVRAS-CHAVE: Unidade de Terapia Intensiva Neonatal. Estimulação Sensório-Motora. Recém-nascidos. Fisioterapeutas. Teoria Síncrono-Ativa do Desenvolvimento.

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1. Introduction

The Neonatal Intensive Care Unit (NICU) is considered an environment of care and protection for the newborn (NB) and has a high potential for impact on the development of this population.¹ However, due to the sensory overload imposed by excessive lighting, high-pitched noises and the frequent care routine with potentially painful handling and procedures²⁻⁴, the NICU can be considered a stressful environment for NBs, who respond in a particular way with changes in their behavior and overall development.^{5,6}

The NB's behavioral response comprises a relationship between stress and the capacity for self-regulation and can be identified by signs of closeness or withdrawal.⁷ The Synchronous-Active Theory of Development (STD) emphasizes that the organization of the organism occurs between the autonomic, motor, behavioral states, attention and social interaction and regulatory subsystems, which interact with each other and, when in harmony, promote a state of homeostasis in NBs.^{7,8}

Since the NB's best development is achieved through the modulation of stimuli that brings about harmony between these subsystems⁸, it is necessary to raise awareness and sensitize NICU professionals to the importance of observing, in addition to clinical signs, the neurobehavioral signs of the NB's approach and retraction and the use of procedures in clinical practice that are capable of promoting the NB's self-regulation.⁸

Sensorimotor stimulation (SMS) is an early intervention used in the NICU to promote the organization of the body's systems. This can reduce neonatal pain and stress, as well as improve vital physiological events, such as sleep and wake cycles and other clinical indicators.⁹ The physiotherapist who uses SMS in their routine must be able to perceive the signs of approach or retraction of the NB associated with the clinical signs presented, and thus judge whether this intervention is being applied effectively and beneficially or whether the stimulus should be discontinued. According to the First Brazilian Physiotherapy Recommendation for SMS, the procedures should be adapted to the specific needs of the NB and the intervention should be performed by experienced professionals.⁹

Given the need to take a careful look at the signs presented by newborns in the NICU, especially those who receive interventions such as SMS that have the ability to alter behavior and hemodynamics, the aim of this study is to analyze the perception of physiotherapists about changes in the autonomic system and the behavioral state of newborns after sensory-motor stimulation procedures.

2. Method

This is a cross-sectional section of an observational study called "Identification of Sensorimotor Stimulation Procedures in a Neonatal Intensive Care Unit" approved by the Human Research Ethics Committee of the State University of Santa Catarina (CAAE 16833019.1.0000.0118).

The sample included physiotherapists working in the NICU, Intermediate Care Unit (ICU) and Neonatal and Pediatric Intensive Care Unit (NPICU) of Brazilian hospitals and maternity hospitals. Physiotherapists working exclusively in the Pediatric Intensive Care Unit (PICU) were excluded. To calculate the sample size, the number of professional specialist physiotherapists specialized in Intensive Care Physiotherapy - Area of Activity Pediatrics and Neonatology by the Association of Cardiorespiratory Physiotherapy and Physiotherapy in Intensive Care (ASSOBRAFIR) in the year of the survey was considered, 719 professionals, with a 5% error rate, giving a total sample size of 251 physiotherapists.¹⁰

Data was collected using an electronic questionnaire designed specifically for this study using the Delphi method.¹¹ The questionnaire was prepared on Google Forms® and publicized in two ways, by active search on social networks and messaging apps (Instagram®, WhatsApp®) and by electronic mail to the physiotherapists members of ASSOBRAFIR, by electronic address registered with the association. The e-mail and active search were started together, and the form was sent out for the second time after 30 days. Data collection ended 90 days after the first mailing, from September to December 2020. The participating physiotherapists were informed about the content and purpose of the study and were required to accept the Free and Informed Consent Form (FICF) to take part in the research, and had their professional records checked prior to data analysis.

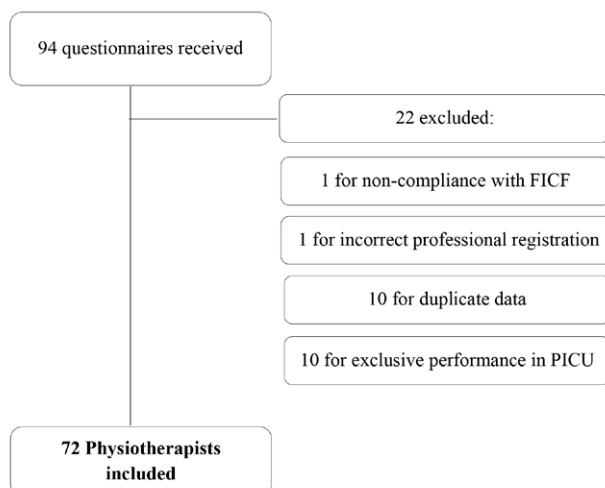
The questionnaire addressed aspects of tactile, vestibular, olfactory, gustatory and visual stimulation. The physiotherapists' perception of the repercussions of the SMS procedures was grouped into "presents" or "does not present", and "increased", "remained stable" or "decreased". The STD's autonomic system was characterized by the variables heart rate (HR), respiratory rate (RR) and oxygen saturation (SpO₂) and the behavioral state was characterized by the variables sleep (deep or active), drowsiness, active alertness, active awakening, and intense crying.

The information extracted from the questionnaires was transcribed to Microsoft Office Excel (Excel®, Natick-MA) and processed in the program Statistical Package for the Social Sciences (SPSS version 21.0). The data relating to physiotherapists' perception of the repercussions of SMS were presented in absolute frequency (n) and relative frequency (%).

3. Results

The sample size consisted of 72 physiotherapists who answered the questionnaire. The flowchart of participants is described in figure 1.

Figure 1. Flowchart of the sample



Abbreviations: FICF: Free and Informed Consent Form; PICU: Pediatric Intensive Care Unit.
Source: the authors (2024).

The characteristics of the physiotherapists who took part in the study are described in Table 1

Table 1. Characterization of Physiotherapists

Characterization	n = 72 (%)
Education	
Undergraduate degree	5 (6.9)
Specialization	35 (48.6)
Medical Residence	12 (16.7)
Master's Degree	17 (23.6)
Doctorate Degree	3 (4.2)
Place of work	
Neonatal Intensive Care Unit	46 (63.9)
Intermediate Care Unit	4 (5.6)
Neonatal and Pediatric Intensive Care Unit	22 (30.5)
Length of time working	
Up to 5 years	34 (47.2)
Over 5 years	19 (26.4)
More than 10 years	19 (26.4)
Region	
North	3 (4.2)
South	28 (38.8)
Southeast	28 (38.8)
North-East	10 (14)
Midwest	3 (4.2)
Origin of the Hospital	
Public	46 (63.9)
Private	18 (25)
Philanthropic	8 (11.1)

Data presented in absolute (n) and relative (%) frequency.
Source: the authors (2024).

Regarding changes in the autonomic system, all the SMS modalities investigated - tactile, vestibular, olfactory and gustatory stimulation - the majority of physiotherapists believe that the HR and RR variables remain stable or decrease and the SpO₂ variable increases or remains stable after performing the different procedures. The perception of physiotherapists according to stimulation groups is described in table 2.

Table 2. Physiotherapists' perception of the impact of SMS on the autonomous system (to be continued)

Group	Procedures	Autonomous system n = 72 (%)											
		HR				RR				SpO ₂			
		I	S	D	NA	I	S	D	NA	I	S	D	NA
Tactile Stimulation	Skin-to-Skin Contact/Kangaroo Position	0 (0)	42 (58.3)	28 (38.9)	2 (2.8)	0 (0)	35 (48.6)	35 (48.6)	2 (2.8)	36 (50)	32 (44.6)	1 (1.3)	3 (4.1)
	Soft Touch	4 (5.6)	45 (62.5)	20 (27.8)	3 (4.1)	3 (4.1)	43 (59.8)	23 (32)	3 (4.1)	19 (26.4)	50 (69.5)	0 (0)	3 (4.1)
	Facilitated Restraint	3 (4.1)	27 (37.5)	32 (44.5)	10 (13.9)	1 (1.3)	27 (37.6)	34 (47.2)	10 (13.9)	28 (38.9)	34 (47.2)	0 (0)	10 (13.9)
	Tactile-Kinesthetic Stimulation	13 (18)	41 (56.9)	4 (5.7)	14 (19.4)	5 (7)	46 (63.9)	7 (9.7)	14 (19.4)	7 (9.7)	50 (69.5)	1 (1.3)	14 (19.5)
	Hot tub/Immersion Bath	0 (0)	12 (16.6)	25 (34.7)	35 (48.7)	1 (1.3)	10 (13.9)	26 (36.1)	35 (48.7)	16 (22.2)	21 (29.2)	0 (0)	35 (48.6)
	Therapeutic massage	1 (1.3)	17 (23.7)	12 (16.7)	42 (58.3)	1 (1.3)	15 (20.9)	14 (19.5)	42 (58.3)	7 (9.7)	23 (32)	0 (0)	42 (58.3)
Vestibular Stimulation	Hammock	1 (1.3)	22 (30.6)	13 (18)	36 (50.1)	1 (1.3)	20 (27.8)	15 (20.9)	36 (50)	8 (11.1)	28 (38.9)	0 (0)	36 (50)
	Lullaby/Gentle Swing	0 (0)	29 (40.2)	22 (30.5)	21 (29.3)	0 (0)	30 (41.6)	21 (29.2)	21 (29.2)	7 (9.8)	43 (59.7)	1 (1.3)	21 (29.2)

Table 2. Physiotherapists' perception of the impact of SMS on the autonomous system (conclusion)

Group	Procedures	Autonomous system n = 72 (%)											
		HR				RR				SpO ₂			
		I	S	D	NA	I	S	D	NA	I	S	D	NA
Olfactory and Gustatory Stimulation	Cotton Woll in Vanilla Essence	0 (0)	3 (4.2)	1 (1.3)	68 (94.5)	0 (0)	3 (4.2)	1 (1.3)	68 (94.5)	1 (1.3)	3 (4.2)	0 (0)	68 (94.5)
	Glucose Solution	0 (0)	9 (12.5)	7 (9.7)	56 (77.8)	0 (0)	7 (9.7)	9 (12.5)	56 (77.8)	3 (4.2)	12 (16.7)	1 (1.3)	56 (77.8)

Legend: I: increased S: stable D: decreased HR: heart rate RR: respiratory rate SPO₂: oxygen saturation NA: not answered. Data presented in absolute (n) and relative (%) frequency.
Source: the authors (2024).

Regarding to changes in behavioral state, for all the modalities of SMS investigated - tactile, vestibular, olfactory, gustatory and visual stimulation - the majority of physiotherapists believe that NBs are actively alert after all the procedures, actively asleep, drowsy and actively alert after the tactile and vestibular stimulation procedures and do not cry intensely after the procedures. The perception of physiotherapists according to stimulation groups is shown in Table 3.

Table 3. Physiotherapists' perception of the impact of SMS on the behavioral state

Group	Procedures	Behavioral status n = 72 (%)												
		DS		AS		DRO		AA		AW		IC		NA
		D	ND	D	ND	D	ND	D	ND	D	ND	D	ND	
Tactile Stimulation	Skin-to-Skin Contact or Kangaroo Position	62 (86.1)	8 (11.1)	51 (70.8)	19 (26.4)	61 (84.7)	9 (12.5)	58 (80.6)	12 (16.7)	27 (37.5)	43 (59.7)	2 (2.8)	68 (94.4)	2 (2.8)
	Soft Touch	35 (48.6)	34 (47.2)	42 (58.3)	27 (37.5)	54 (75)	15 (20.8)	63 (87.5)	6 (8.3)	40 (55.6)	29 (40.3)	7 (9.7)	62 (86.1)	3 (4.2)
	Facilitated Restrain	47 (65.3)	15 (20.8)	44 (61.1)	18 (25)	56 (77.8)	6 (8.3)	57 (79.2)	5 (6.9)	26 (36.1)	36 (50)	7 (9.7)	55 (76.4)	10 (13.9)
	Tactile-Kinesthetic Stimulation	9 (12.5)	49 (68.1)	31 (43.1)	27 (37.5)	37 (51.4)	21 (29.2)	55 (76.4)	3 (4.2)	43 (59.7)	15 (20.8)	12 (16.7)	46 (63.9)	14 (19.4)
	Hot tub/Immersion Bath	19 (26.4)	18 (25)	23 (31.9)	14 (19.4)	36 (50)	1 (1.4)	35 (48.6)	2 (2.8)	17 (23.6)	20 (27.8)	7 (9.7)	30 (41.7)	35 (48.6)
	Therapeutic massage	20 (27.8)	10 (13.9)	21 (29.2)	9 (12.5)	27 (37.5)	3 (4.2)	30 (41.7)	0 (0)	17 (23.6)	13 (18.1)	5 (6.9)	25 (34.7)	42 (58.3)
Vestibular Stimulation	Hammock	29 (40.3)	7 (9.7)	27 (37.5)	9 (12.5)	34 (47.2)	2 (2.8)	32 (44.4)	4 (5.6)	19 (26.4)	17 (23.6)	7 (9.7)	29 (40.3)	36 (50)
	Lullaby/Gentle Swing	36 (50)	15 (20.8)	41 (56.9)	10 (13.9)	48 (66.7)	3 (4.2)	46 (63.9)	5 (6.9)	29 (40.3)	22 (30.6)	7 (9.7)	44 (61.1)	21 (29.2)
Olfactory and Gustatory Stimulation	Cotton wool in vanilla essence	3 (4.2)	2 (2.8)	3 (4.2)	2 (2.8)	4 (5.6)	1 (1.4)	3 (4.2)	2 (2.8)	2 (2.8)	3 (4.2)	0 (0)	5 (6.9)	67 (93.1)
	Glucose solution	16 (22.2)	24 (33.3)	28 (38.9)	12 (16.7)	31 (43.1)	9 (12.5)	37 (51.4)	3 (4.2)	19 (26.4)	21 (29.2)	10 (13.9)	30 (41.7)	32 (44.4)
Visual Stimulation	Face to face	3 (4.2)	41 (56.9)	8 (11.1)	36 (50)	10 (13.9)	34 (47.2)	41 (56.9)	3 (4.2)	34 (47.2)	10 (13.9)	6 (8.3)	38 (52.8)	28 (38.9)
	Cards with black and white pattern	0 (0)	36 (50)	5 (6.9)	31 (43.1)	9 (12.5)	27 (37.5)	34 (47.2)	2 (2.8)	25 (34.7)	11 (15.3)	3 (4.2)	33 (45.8)	36 (50)

Legend: DS: deep sleep AS: active sleep DRO: drowsiness AA: active alert AW: active awakening IC: intense crying D: presented ND: did not present NA: not answered. Data presented in absolute (n) and relative frequency (%).
Source: the authors (2024).

4. Discussion

This study provides an insight into physiotherapists' perceptions of changes in newborns' systems following SMS procedures. About the autonomic system, after tactile procedures, the physiotherapists noticed stability or a decrease in HR and RR, and stability in SpO₂, and after vestibular procedures, stability in HR, RR and SpO₂. Regarding behavioral state, the physiotherapists perceived active sleep, drowsiness, and active alertness after all the tactile and vestibular stimulation procedures, and active alertness after all the SMS procedures, and none reported the perception of intense crying. These findings confirm the importance of SMS for NB care.

Seventy-two physiotherapists responded with their perceptions. Most of these professionals had specialized degrees and worked in NICUs, coming from public hospitals in the south-east and south of Brazil. Similarly to this research, in a study with a comparable methodology, the majority of physiotherapists had specialized and master's degrees and lived in the southeast of the country.¹² These results may be related to the distribution of NICU beds in Brazil, as the south-eastern region has the highest distribution of beds per 1,000 live births, followed by the south¹³, which justifies the higher number of specialist physiotherapists working in these units.

SMS procedures are known to alter the clinical conditions of NBs, as well as cardiorespiratory aspects⁹, including HR, RR and SpO₂. The physiotherapists' perception of autonomic system variables in response to the application of SMS procedures, according to the tactile stimulation group, was, in skin-to-skin contact, stability of HR, stability or decrease in RR and increase in SpO₂. In facilitated restraint, the perception was that HR and RR decreased and SpO₂ remained stable. In soft touch and tactile-kinesthetic stimulation, the physiotherapists' perception was of stability for all three variables (HR, RR and SpO₂).

The results of this research corroborate the First Brazilian Physiotherapy Recommendation for SMS⁹, in which unimodal tactile stimulation has a moderate degree of scientific evidence, and skin-to-skin contact has a strong degree of scientific evidence in relation to improving vital physiological events,

such as regulating RR, HR, SpO₂, temperature and reducing apnea episodes.⁹ Therefore, we can see that the physiotherapists taking part in the study have perceptions that are consistent with the literature regarding the known effects of SMS.

Otoni and Grave⁸ assessed the neurobehavioral signs from the perspective of the STD of 11 NBs admitted to the NICU during routine nappy changing, and observed 13 signs related to the autonomic subsystem, 5 of which were approach signs and 8 withdrawal signs. The authors concluded that these NBs had a low rate of approach signs in routine procedures and that the best overall development of the NB can be achieved through the correct modulation of stimuli, thus requiring professionals who are able to analyze and interpret these signals.⁸ These findings justify interventions such as SMS, which can provide organization to the systems of NBs admitted in the NICU.

In the vestibular stimulation group, in the lullaby or gentle swing procedure, the physiotherapists noticed stability in HR, RR and SpO₂. In this study, vestibular stimulation was integrated in a unimodal way; however, in the First Brazilian Physiotherapy Recommendation for SMS⁹, this modality was included among the multimodal SMS methods. It is known that multimodal vestibular stimuli, i.e. combined with auditory, tactile and visual stimuli, can improve muscle tone¹⁴, mother-baby interaction¹⁵, weight gain¹⁶, behavioral organization and alertness.^{17,18} These findings confirm the fact that the physiotherapists taking part in this study have perceptions consistent with what is described in the literature, namely the stability of physiological variables. They also reinforce the importance of using these procedures in NICUs to provide greater organization of NB systems.

Most physiotherapists did not answer their perception of changes in HR, RR and SpO₂ in hot tub or immersion bath procedures, therapeutic massage, hammocks, cotton wool in vanilla essence and the use of glucose solution. It is thought that the reason for these findings may be that these procedures are less frequently used by physiotherapists in NICU clinical practice, as they require resources such as more than one professional working, specific equipment, and more time to perform. As a result, there is a need for studies that systematize the practice and frequency of SMS procedures in the NICU routine.

In a study performed with a health team from a Brazilian NICU, both senior and mid-level professionals reported that they use physiological signs, such as an increase in HR and RR and a decrease in SpO₂, to empirically identify pain in premature NBs.¹⁹ Furthermore, 28.6% of higher education professionals pointed to an increase in HR, 22.9% to an increase in RR and 25.7% to a decrease in SpO₂ as a sign of pain. These results strengthen the perception of the organization of the autonomic system after SMS procedures, since most physiotherapists reported seeing stability or a decrease in HR and RR, and stability or an increase in SpO₂ in most of the procedures studied.

Regarding behavioral status, the physiotherapists' perception is that NBs show active sleep, drowsiness, and active alertness because of all tactile stimulation procedures. In vestibular stimulation procedures, the perception of deep sleep, active sleep, drowsiness, active alertness, and active awakening behaviors was reported; in olfactory and gustatory stimulation, active sleep, drowsiness, and active alertness behaviors; and in visual stimulation, active alertness and active awakening behaviors. Intense crying was not perceived by most professionals in any of the procedures.

In a study on the effect of the tactile-kinesthetic stimulation procedure on the behavioral pattern of NBs, data was collected on the clinical evolution of 32 premature NBs until hospital discharge and it was concluded that this procedure contributes to behavioral regulation, with the intervention group prevailing in regular breathing, alertness, balanced tone, mixed postures, coordinated movement, hand movements on the face, sucking, grasping and support.²⁰ Corroborating these clinical indicators, according to the First Brazilian Physiotherapy Recommendation for SMS⁹, tactile and auditory stimulation and tactile-kinesthetic stimulation procedures have a moderate degree of scientific evidence, and taste stimulation, massage and skin-to-skin contact procedures have a strong degree of scientific evidence in the behavioral organization, which comprises the STD regulatory system.

In addition, the study by Santos et al.¹⁹ which analyzed the process of identifying pain in newborns by the multi-professional team of a Brazilian NICU, regarding changes in behavioral status, of the professionals who identified pain in premature newborns, 12%

considered crying to be the main sign of pain and 10.9% believed that movements of the legs, arms and squeezed eyes indicate signs of the presence of the painful process. As seen in the systematic review by Franco et al.²¹ and in the study by Sadek and Abdelhamed²², SMS procedures generate short- and long-term benefits for NBs, with pain reduction being one of these immediate benefits. Therefore, the perception of the physiotherapists in this study is in line with what is described in the literature, since, although the physiotherapists perceived a variety in the behavioral state of NBs, intense crying, a sign of disorganization and possible pain, was not perceived by the majority of professionals.

Similarly, in the systematic review conducted by Khurana et al.²³ on the effect of neonatal therapies on the motor, cognitive and behavioral development of premature NBs, it was found that developmental care programs for NBs designed by specialist therapists appear to be effective in improving motor development and behavior in the short term. These findings are relevant because they show the importance of performing interventions in the NICU that have an immediate effect on the organization of the NB's systems.

As shown in the First Brazilian Physiotherapy Recommendation for SMS, all modalities have good evaluations for controlling pain and stress in NBs⁹. Taking that in consideration, a Brazilian field study analyzed the effects of SMS on these two parameters in premature NBs and positive responses were observed. Furthermore, the authors observed changes in physiological variables, such as a reduction in HR and RR, and an increase in SpO₂, as did most of the physiotherapists in this study.²⁴ Since there is limited evidence on the effects of neonatal interventions on child development outcomes, longitudinal studies, preferably controlled and randomized, could be designed to test the hypothesis of the effectiveness of specific procedures on different variables.²⁵

Although this study is a pioneer in providing information on the practice of Brazilian physiotherapists in relation to SMS procedures applied in neonatal units and their perceptions, the low rate of adherence by professionals was considered a limitation, with 28.6% of the sample calculation being achieved, a figure lower than initially estimated. It is assumed that one of the reasons for this result is the lack of adherence to surveys with questionnaires sent

online, which was also evidenced in a study using a similar methodology.¹² Moreover, the length of the questionnaire and the time taken to complete it may have limited the number of responses received, factors which may be strongly related to the global pandemic situation at the time the data was collected.

Therefore, as future directions, it is suggested that this study be reproduced to achieve external validity, that is, with a sample number representative of the number of physiotherapists working in NICUs in Brazil. In addition, we suggest investigating the perceptions of physiotherapists working in NICUs in the light of the repercussions of SMS on NBs after the publication of the First Brazilian Physiotherapy Recommendation for SMS and the practice of SMS by physiotherapists in NICUs and their respective criteria for use in order to provide specific training for professionals.

It is hoped that this study will raise awareness among professionals of the importance of perceiving the often-subtle signs presented by NBs, in order to determine whether the intervention applied is fulfilling its purpose. From the results obtained, it can be concluded that the perception of the physiotherapists who responded on the outcomes of the NB's autonomic system after tactile procedures was stability or decrease in HR and RR, and stability in SpO₂, and after vestibular procedures was stability in HR, RR and SpO₂. Regarding the behavioral state, the physiotherapists' perception is that NBs show active sleep, drowsiness and active alertness after all tactile stimulation and vestibular stimulation procedures. Furthermore, most physiotherapists reported the perception of active alertness after all SMS procedures, and none reported the perception of intense crying.

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Authors' contributions

Martins TB, Nodari T, Coelho F, Pereira AS and Montemezzo D took part in storing, processing, analyzing, and interpreting the data, as well as writing the manuscript. All the authors participated in the conception, design, and critical review of the relevant intellectual content. All the authors have reviewed and approved the definitive version and agree to its publication. The authors are responsible for all aspects of the work.

Conflicts of interest

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