

# Neurobehavioral signals in preterm infants in body weight check: a quasi-experimental study

*Sinais neurocomportamentais em prematuros na verificação do peso corporal: estudo quase-experimental*

*Señales neuroconductuales en prematuros en la verificación del peso corporal: un estudio cuasiexperimental*

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## ABSTRACT

**Objective:** to describe and compare the frequency of neurobehavioral signs in preterm infants in traditional and humanized body weight check. **Methods:** a quantitative, quasi-experimental, cross-over study, carried out in a Neonatal Unit at a university hospital with a sample of 30 preterm newborns, randomly assigned and allocated in control group (traditional) and intervention group (humanized), with collection of general data, vital signs before and after procedures and footage. **Results:** there was a higher frequency of approach signs in humanized weight check compared to traditional check. Moreover, withdrawal signs were more frequent in traditional weight check compared to humanized check. **Conclusion:** in this regard, humanized body weight check provided greater benefits to preterm infants, making it necessary to foster discussions about humanization of care, so that this practice can be performed routinely in health units.

**Descriptors:** Infant; Premature; Neurobehavioral Signs; Humanization of Assistance; Intensive Care; Neonatal; Body Weight.

## RESUMO

**Objetivos:** descrever e comparar a frequência dos sinais neurocomportamentais em prematuros na verificação do peso corporal de forma tradicional e humanizada. **Método:** estudo quantitativo, quase-experimental, tipo *cross-over*, realizado em uma Unidade Neonatal de um hospital universitário com amostra de 30 recém-nascidos prematuros, randomicamente assinalados e alocados no grupo controle (tradicional) e no grupo intervenção (humanizada), com a coleta de dados gerais, sinais vitais antes e depois dos procedimentos e filmagem. **Resultados:** observou-se uma frequência maior dos sinais de aproximação na verificação do peso de forma humanizada em relação à tradicional. Além disso, os sinais de retraimento se mostraram mais frequentes na verificação do peso de forma tradicional em comparação à humanizada. **Conclusão:** desse modo, a verificação do peso corporal de forma humanizada proporcionou maiores benefícios aos prematuros, tornando-se necessário estimular discussões sobre a humanização da assistência, para que esta prática possa ser realizada de forma rotineira nas unidades de saúde.

**Descritores:** Recém-Nascido Prematuro; Sinais Neurocomportamentais; Humanização da Assistência; Terapia Intensiva Neonatal; Peso Corporal.

## RESUMEN

**Objetivo:** describir y comparar la frecuencia de signos neuroconductuales en prematuros en la verificación del peso corporal de forma tradicional y humanizada. **Métodos:** estudio cuantitativo, cuasiexperimental, *cross-over*, realizado en una Unidad Neonatal de un hospital universitario con una muestra de 30 recién nacidos prematuros, asignados aleatoriamente y asignados en el grupo control (tradicional) y en el grupo intervención (humanizado), con la recolección de datos generales, signos vitales antes y después de los procedimientos y filmaciones. **Resultados:** hubo mayor frecuencia de señales de acercamiento en la verificación de peso de forma humanizada en comparación con la forma tradicional. Además, los signos de retracción fueron más frecuentes en la verificación de peso de forma tradicional en comparación con la forma humanizada. **Conclusión:** de esa forma, la verificación del peso corporal de forma humanizada proporcionó mayores beneficios a los prematuros, siendo necesario estimular discusiones sobre la humanización de la atención, para que esa práctica pueda ser realizada de forma rutinaria en las unidades de salud.

**Descritores:** Recién-Nacido Prematuro; Signos Neuroconductuales; Humanización de la Atención; Cuidado Intensivo Neonatal; Peso Corporal.

## INTRODUCTION

It is estimated that, annually, about 2.4 million children in the world die as a result of prematurity in the first 28 days of life, associated with lack of quality care at birth and specialized treatment immediately after birth and in the first days of life<sup>(1)</sup>. In Brazil, although the infant mortality rate declined from 47.1 in 1990 to 13.3 infant deaths in 2019, as a result of the considerable reduction in the post-neonatal component, neonatal mortality, which decreased by 25.33 to 8.5 in the same period, remains the main component of infant mortality<sup>(2)</sup>.

Prematurity can still cause several complications arising from bodily immaturity and intensive, invasive and painful care applied to preterm newborns (PTNBs), such as cerebral palsy, seizures, heart disease, recurrent respiratory disorders, among others. Many survivors may still face a lifetime of disability, including learning disabilities and motor, visual and hearing problems, significantly reducing the human potential for lifelong health and well-being, generating new diseases and disabilities<sup>(3)</sup>.

In view of this perspective of neonatal and child health, the World Health Organization (WHO) proposed, in 2015, new challenges through the agreement of Sustainable Development Goals (SDGs), based on 17 objectives and 169 targets to be achieved by all countries in the agreement between 2016 and 2030. This document includes, in addition to reducing infant mortality, a concern with quality of life, with the aim of minimizing deficiencies and ensuring that PTNBs develop in a healthy way<sup>(4)</sup>.

In this context, the WHO strongly recommends the establishment of measures to prevent and mitigate the sequel of PTNBs through the adoption and strengthening of strategies to humanize care. These humanized actions aim to reduce unnecessary exposure of PTNBs during direct care and in relation to the unit environment, such as light, noise, sudden temperature differences, invasive objects such as tubes and catheters, which cause pain and discomfort, preventing, in most cases, sleep, which is extremely important for the development of newborns (NB). It also recommends actions that strengthen the bond and early contact of NBs with the family, thus avoiding the emergence of neurotoxic episodes, which are harmful to the infant's brain<sup>(5)</sup>.

In order to minimize the stressful effects that these PTNBs experience daily, in the 80s, the Neonatal Individualized Developmental Care and Assessment Program (NIDCAP) was created, considered the gold standard for excellence in care for the individualized development of NBs. This program seeks to positively change the environment of Neonatal Units (NU), comprising the Neonatal Intensive Care Units (NICU) and the Conventional Neonatal Intermediate Care Unit (CoNICU), proposing interventions that include noise reduction, lighting, in addition to minimal handling, which helps to promote longer rest periods for PTNBs, thus reducing the high level of irritability that the environment causes. The reduction of tension in the environment can also be acquired through family introduction in PTNB support, giving it the opportunity to participate in the care process<sup>(5)</sup>.

The NIDCAP is based on the premise that NBs communicate with the external environment through the neurobehavioral signals of approach (comfort) and withdrawal (stress), and, from these signals cited in the Synactive Theory of Development (STD),

reading infants' behavior can be obtained through the simple observation of the infant's reactions to stimuli, indicating the limit that NBs have in relation to stress and their ability to self-regulate. This theory guides developmental care, as it describes the interrelationship of subsystems (autonomous, motor, behavioral states, attention and social interaction, and regulatory system) with each other and with the external environment. Through it, communication between NBs and trained health professionals becomes clearer, who will be able to modulate the handling in the face of the sign of stress, as well as reassess behaviors that were previously focused on ease and practicality to propose respectful care in order to preserve the brain of PTNBs<sup>(6)</sup>.

In this sense, in order to minimize the impacts of the external environment, it is mentioned humanized body weight check, a practice recommended by the Ministry of Health in the Technical Manual of Humanized Care to Low Weight Newborns - Kangaroo Method. Although there is no scientific evidence on this procedure, it is believed that this humanized weight check can reduce the stress suffered by PTNBs, since the infant appears to be more organized. On the other hand, the traditional way seems to be more stressful for the infant, but it is still part of the routine of many NU, many times, if it is believed that it is a faster and more practical procedure<sup>(7)</sup>.

From these perspectives and aiming at assessing performance between the two techniques based on behavioral differences expressed by PTNBs, the study hypothesis was defined: humanized weight check in PTNBs admitted to the NU is less stressful than traditional check.

## OBJECTIVES

To describe and compare the frequency of neurobehavioral signs in preterm infants in traditional and humanized body weight check.

The study is justified by the need to prevent PTNB adversities and exposure to toxic stress during daily care, thus avoiding damage to brain architecture and reduced brain volume, as well as consequences on behavioral outcomes for language and academic performance. This study includes international recommendations for investments in care during the first years of life, which aim to benefit, in addition to PTNBs and their families, communities and countries through greater cohesion, social stability and greater productivity and gains.

The study theme is relevant, as there is a scarcity of research that deals with this subject. In this sense, when searching in two databases (Virtual Health Library (VHL) and United States National Library of Medicine (PubMed)), from 6 combinations of 4 descriptors (body weight, PTNB, neurobehavioral manifestations, humanization of care) and 1 keyword (weighing) in 3 languages (Portuguese, Spanish and English), about 2,671 articles can be obtained from the VHL, which are refined in the sequence through the filter: only articles, age group only in NBs, languages only in Portuguese, Spanish and English and time of publication less than or equal to ten years (2011-2021), leaving 624 articles. Subsequently, seven repeated articles and 598 were excluded due to non-adherence to the proposed theme. The articles were about the Kangaroo Method (KM), its implementation and repercussions

in the NICU, analysis of clinical outcomes, growth dynamics and rates of exclusive breastfeeding, among other researches with different aspects, even if related to the humanization of care and great potential for use in favor of preterm infants, but which are not used in the theme of this research. After reading full texts of articles with eligibility criteria, seven articles that fit the study theme were obtained as a final result of inclusion.

In PubMed, in all, 18,654 articles were found, and from them, the same filters were used, resulting in 4,732 articles, 4,672 publications were excluded because they did not fit the topic in this study, and we obtained 60 articles. After reading, articles were discarded that related to syndromes, language delays, feeding forms, body composition, differences and classifications of birth weight, malnutrition, among others. Finally, 12 articles were selected for the eligibility criterion. After finishing the reading of abstracts, four articles were finally included.

Summing up, of the 21,325 articles identified by the six combinations in each bank, 11 articles were included in the search. Even if included in the research, none of them is related to the weighing technique, nor the differences between the two techniques (traditional and humanized) and their manifestations in NBs, which demonstrates the deficiencies in the information and knowledge system. Only two articles were about neurobehavioral assessments. Some authors<sup>(8)</sup> addressed early neurobehavioral development among preterm infants and term infants. Different results influenced by their different gestational age and others<sup>(9)</sup> specifically sought to identify neurobehavioral manifestations in preterm infants in the NICU in daily procedures not specified in the unit. Thus, the integrative review can verify that neurobehavioral signs are being approached in research with discretion and without the application in interventions, in order to measure the frequency of these signs and, in some way, compare traditional techniques with humanized techniques proposed in ministerial manuals.

## METHOD

### Ethical aspects

The study was approved by the institution's Research Ethics Committee, according to Resolution 466/12 of the Brazilian National Health Council of the Ministry of Health, which regulates research with human beings. Participants' guardians signed the Informed Consent Form and the Newborn Photography Consent Form.

### Study design, place and period

This is a quasi-experimental, cross-over study with a quantitative approach, which submitted PTNBs to two types of body weight check techniques (traditional and humanized) and assessed the influence of this practice on neurobehavioral signals. All participants received, at random, the two weight check techniques, being allocated in the control group, at the time of traditional weight check, and in the intervention group, during humanized weight check. As it is a cross-over study, NBs were considered their own control, extinguishing the variation between infants.

According to the very nature of the interventions, it was not possible for the researchers to remain blind during data collection

and image encoding. Blinding was only possible in the database construction and during statistical analysis, and the interventions were named intervention 1 and intervention 2. The Consolidated Standards Of Reporting Trials<sup>(10)</sup> (CONSORT) was used to assist in the study report.

The research setting was a NU, which comprises the NICU and CoNICU of a university hospital in Rio de Janeiro, and data were collected from March 2019 to March 2020.

### Study population, and inclusion and exclusion criteria

The study population, selected by convenience sample<sup>(11)</sup>, was composed of 30 PTNBs who were hospitalized at the NICU and who met the inclusion and exclusion criteria. The research inclusion criteria were: gestational age less than 37 weeks; more than 96 hours of life; more than 24 hours of hospitalization, in order to minimize the stress caused by the need for multiple procedures; interval of at least 1 hour from the diet and stable physiological parameters. Exclusion criteria were: use of oxygen therapy; having had an episode of vomiting or regurgitation within 24 hours of participation in the study; apnea less than 72 hours; having been submitted to painful procedures less than 1 hour ago; having a congenital anomaly; having involvement of the Central Nervous System; have injuries or bone fractures and the legal guardian chooses not to participate in the study. After the inclusion and exclusion criteria, the study population consisted of 30 PTNBs. The population distribution is found in the flow diagram (Figure 1).

### Study protocol

A form of observation of neurobehavioral signs prepared by the research team from the perspective of STD was used as a data collection instrument<sup>(6)</sup>, which contains the signs of approach and withdrawal, to check the presence or absence, in addition to the variables sex, type of delivery, reason for delivery, classification of prematurity and classification of birth weight.

Still in the same collection instrument, in order to facilitate the control of possible environmental variables, it contained an environmental control checklist with information on the time of the procedure, time for turning off the air conditioning before the procedure, absence of direct lighting on the site of the procedure and lack of flow of personnel and practice of procedures at the time of collection.

It is noteworthy that NBs' environmental and clinical variables were controlled by the researchers. Clinical variables were controlled through inclusion and exclusion criteria, and environmental variables, by turning off the air conditioning 20 minutes before the procedure, as well as controlling noise and light in the place and respecting the unit's routine time for carrying out the weighing, when there is less flow of personnel and practice of procedures.

Data collection operationalization was carried out based on the inclusion and exclusion criteria for the selection of NBs eligible for the process, approach of the person in charge for authorization and signatures of research and footage terms.

Data collection was carried out during body weight check, choosing the time of 7:30 in the morning, before carrying out

the daily hygiene and feeding care of PTNBs, in order to reduce the interference in the unit's routine. The initial completion of the observation form occurred, through patients' medical records, before the footage of the procedure. Then, vital signs were recorded on the form before and after the procedure, and the completion of the observation form was finally completed after assessing the footage of each PTNB.

Weight check was conducted in a standardized manner by 3 neonatal nurses, researchers and trained with a tutor from the KM, for a month, according to the Ministry of Health recommendations<sup>(12)</sup>. Infants received both forms of weight check, control (traditional) and intervention (humanized), and the allocation order was defined by randomization for the first day. Randomization was performed by an independent researcher, external to the research, through the website [www.randomization.com](http://www.randomization.com). Then, a randomization table was created, in chunks of individuals, with the permutation of the two groups: control (traditional weighing) and intervention (humanized weighing). Then, the same external researcher distributed the random sequence of weighing for each PTNB in opaque envelopes, sequentially, numbered and sealed, confidentially until the time of collection. Body weight check followed the minimum interval of 24 hours (washout) between the two techniques, thus avoiding the residual effect of one intervention on the other (carry-over). To measure the weight of all PTNBs, the BP Baby – Filizola infant digital scale was used.

Traditional weight check took approximately 2 minutes and was performed with NBs completely undressed, then placed on the scale previously sanitized with 70% alcohol and covered with a paper towel, on which the weight value was determined. At the time of lower movement of PTNBs. After removing the infant from the scale, the nurse recorded the checked weight, discarded the paper towel, disinfected the scale again with 70% alcohol and then sanitized the hands.

Humanized body weight check<sup>(12)</sup> lasted approximately 1 minute, and was performed after scale disinfection with 70% alcohol. Thus, the fabric was weighed, and after obtaining the value, the scale was tared. After this care, NBs were undressed and wrapped with fabric, of previously known weight. Then, NBs were put on the scale and, after stabilizing their weight, they were removed. Finally, a nurse recorded the checked weight, discounting the value of the tissue, performed a new scale plate disinfection with 70% alcohol, sanitizing the hands.

For a more accurate assessment of neurobehavioral signs in humanized weight check, it was decided to use a white organza fabric to wrap the NBs, making it possible to assess the movement of the trunk and limbs due to their transparency.

The weighing footage was taken by a trained research assistant using a Samsung S8 cell phone (after being saved in the database, the videos were permanently deleted from the electronics). The cameraman presented an appropriate position so as not to disturb the passage from the bed to the scale, catching full view of NBs. Footage duration lasted approximately 2 minutes.

### Analysis of results, and statistics

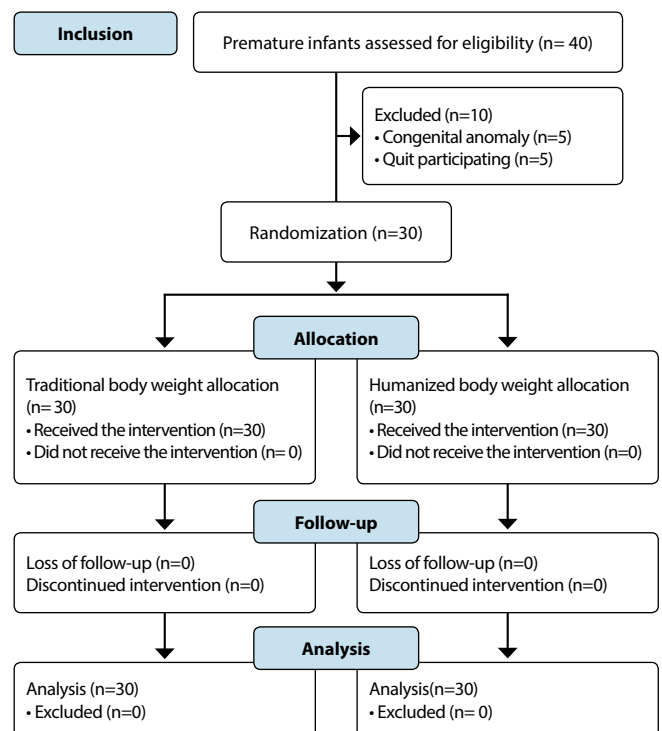
Descriptive analysis of data on signs of withdrawal and approach in the different subsystems, according to body weight check

techniques (traditional and humanized), was performed using absolute (n) and relative frequencies (%), medians and interquartile ranges (1<sup>st</sup> quartile - 3<sup>rd</sup> quartile). Wilcoxon's nonparametric test for paired samples was used to test possible differences between the withdrawal and approach signals and the weight check techniques. Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS), version 20.0 (IBM Corp, NY, United States), considering a significance level of 5%.

## RESULTS

Regarding the profile of the 30 PTNBs, it was observed that 20 (66.7%) were born by cesarean section. Regarding sex, among them, 15 (50%) are female, and the most prevalent was preeclampsia, present in 11 (36.7%). Regarding prematurity degree, it is noteworthy that 19 (63.3%) were moderate to late. Regarding birth weight classification, most infants (18.60%) had low birth weight (Table 1).

Table 2 shows the withdrawing signals of the 30 PTNBs in the subsystems as follows: autonomous, motor and behavioral and attention and interaction states according to the type of body weight check. Data show that 18 (60%) of NBs presented tremulousness as signs of withdrawing in the autonomic subsystem, during the traditional technique. In the humanized technique, 3 (10%) subjects manifested sudden movements. Regarding hyperextension of legs, the most prevalent number was 30 (100%) in the traditional and 21 (70%) in the humanized subsystem. In the behavioral and attention and interaction state subsystems, 30 (100%) presented in both weights astonished, fixed and apathetic gaze as values of greater recurrence (Table 2).



Source: adapted according to Consort (<http://www.consort-statement.org/consort-statement/flow-diagram>). Rio de Janeiro, Rio de Janeiro, Brazil, 2019-2020.

Figure 1 - Sample screening flow diagram

**Table 1** - Profile of premature newborns, Rio de Janeiro, Brazil, 2021 (N=30)

Characteristics	n	%
Reason for childbirth		
Pre-eclampsia	11	36.7
Water break	4	13.3
Premature labor	3	10.0
Urinary tract infection	2	6.7
Risk pregnancy	2	6.7
Triplet pregnancy	2	6.7
Systemic lupus erythematosus	2	6.7
Increased umbilical resistance	1	3.3
Cord prolapse	1	3.3
Oligohydramnios	1	3.3
Hyaline membrane disease	1	3.3
Sex		
Female	15	50.0
Male	15	50.0
Type of childbirth		
Vaginal	10	33.3
Caesarean section	20	66.7
Prematurity degree		
Extreme premature	1	3.3
Very premature	10	33.3
Moderate to late	19	63.3
Birth weight		
Normal weight	2	6.7
Low weight	18	60.0
Very low weight	7	23.3
Extremely low weight	3	10.0

Signs of withdrawal are negative neurobehavioral responses, which represent a state of high stress, in which they point out to professionals that PTNBs are receiving more stimuli than they can tolerate at that moment, and with this, if possible, one should wait for a more opportune moment to perform a new approach.

**Table 2** - Withdrawing signals in different subsystems according to traditional and humanized body weight check techniques, Rio de Janeiro, Brazil, 2021 (N=30)

Withdrawing	Body weight check technique			
	Traditional		Humanized	
	n	%	n	%
Autonomic	30			
Tremulousness	18	60.0	2	6.7
Sudden movements	14	46.7	3	10.0
Scares	13	43.3	1	3.3
Change in skin color	12	40.0	0	-
Irregular breathing	6	20.0	0	-
Sneeze	0	-	2	6.7
Motor				
Hyperextension of legs	30	100.0	21	70.0
Finger splays	26	86.7	5	16.7
Facial grimacing	18	60.0	8	26.7
Hyperextension of trunk	13	43.3	0	-
Greeting	8	26.7	0	-
Tongue extension	3	10.0	2	6.7
Behavioral and attention and interaction states				
Apathetic stare	30	100.0	30	100.0
Irritability	13	43.3	1	3.3
Whimpering	9	30.0	4	13.3
Strained fussing or crying	9	30.0	1	3.3
Inconsolability	6	20.0	0	-
Discharge smiling	6	20.0	0	-
Silent cry	5	16.7	1	3.3
Glassy-eyed	4	13.3	3	10.0
Gaze aversion	2	6.7	0	-
Staring	1	3.3	0	-

**Table 3** - Approach signals in different subsystems according to traditional and humanized body weight check techniques, Rio de Janeiro, Brazil, 2021 (N=30)

Approach	Body weight check technique			
	Traditional		Humanized	
	n	%	n	%
Autonomic	30			
Stable color	18	60.0	30	100.0
Regular breathing	6	20.0	13	43.3
Motor				
Semiflexion or flexion of arms, legs, and trunks	14	46.7	19	63.3
Grip movement	14	46.7	7	23.3
Hand-to-face	10	33.3	10	33.3
Bulkhead search	8	26.7	8	26.7
Tucking	6	20.0	15	50.0
Foot clasping	6	20.0	8	26.7
Hand-to-mouth	6	20.0	5	16.7
Hand holding	6	20.0	3	10.0
Contacts of hands and feet with surfaces	5	16.7	7	23.3
Grasping	5	16.7	3	10.0
Relaxed face	4	13.3	21	70.0
Suck searching and sucking	3	10.0	1	3.3
Intertwined fingers	3	10.0	1	3.3
Fixed vision, hearing	1	3.3	13	43.3
Biting	1	3.3	5	16.7
Coordinated movements	0	-	18	60.0
Coordinated smooth movements	0	-	14	46.7
Suction search and effective suction	0	-	7	23.3
Behavioral and attention and interaction states				
Calm down easily	3	10.0	11	36.7
Eyebrow elevation	2	6.7	5	16.7

The signs of approach in the autonomic, motor, behavioral and attention and interaction states subsystems, according to body weight check techniques, analyzed in 30 PTNBs, are presented in Table 3. The number of PTNBs who expressed signs of approach of greater prevalence in the autonomic subsystem, during the traditional and humanized technique, respectively, was 18 (60%) and 30 (100%) through the sign of stable color. In the motor subsystem, the most prevalent was the amount of 14 (46.7%) NBs expressing semi-flexion or flexion of arms, legs and trunks in the traditional way, while in the humanized, 21 (70%) they showed a relaxed face. In the behavioral and attention and interaction states subsystems, 3 (10%) and 11 (36.7%) calmed easily in traditional and humanized weighing, respectively (Table 3).

The signs of withdrawal and approach in the different subsystems, according to the body weight check technique, were described by means of frequency, median and interquartile range in Table 4. When comparing the median values, it can be observed that statistically differences were found significant (p-value < 0.05) for all signs of withdrawal, according to the body weight check technique (Table 4).

## DISCUSSION

Regarding participant profile, it was found that most infants were classified as moderate to late preterm infants, which is determined by birth between 32 and 37 weeks, followed by very preterm infants, when they are born between 28 and 31 weeks and only one extreme preterm infant, with less than 28 weeks of gestational age<sup>(13)</sup>.

**Table 4** - Frequencies, median and interquartile range of approach signals in the different subsystems according to traditional and humanized body weight check techniques, Rio de Janeiro, Brazil, 2021 (N=30)

	Body weight check type										p value
	Traditional					Humanized					
	n	%	Median	Interquartile range		n	%	Median	Interquartile range		
			1 <sup>st</sup> quartile**	3 <sup>rd</sup> quartile**				1 <sup>st</sup> quartile**	3 <sup>rd</sup> quartile**		
Withdrawing											
Autonomic	26	86.7	6.00	1.75	6.00	9	30.0	1.00	1.00	1.00	0.001
Motor	30	100.0	18.50	14.00	18.50	26	87.6	2.00	1.75	2.00	0.001
Attention and interaction state	18	60.0	4.50	1.75	4.50	6	20.0	1.00	1.00	1.00	0.001
Approach											
Autonomic	19	63.3	1.00	1.00	1.00	30	100.0	1.00	1.00	1.00	0.002
Motor	27	90.0	4.00	3.00	4.00	29	96.7	7.00	3.00	7.00	0.022
Attention and interaction state	4	13.3	1.50	1.00	1.50	13	43.3	1.00	1.00	1.00	0.005

\*P value obtained through Wilcoxon's nonparametric test for paired samples. \*\*1<sup>st</sup> quartile is equivalent to the 25<sup>th</sup> percentile (P25); 3<sup>rd</sup> quartile is equivalent to the 75<sup>th</sup> percentile (P75).

Regarding the classification according to birth weight, most participants presented low weight, determined by weight between 1,500 g and 2,500 g, followed by very low weight, between 1,000 g and 1,500 g, and extreme low weight, below 1,000 g. Only two infants were weighing more than 2,500 g, considered normal weight<sup>(14)</sup>.

Prematurity and low birth weight are strongly associated with neonatal mortality, and extreme preterm infants and those with extreme low birth weight are hundreds of times more likely to die up to the first 28 days of life compared to full-term NBs. Thus, birth weight represents an important differential in this phase, when the probability of death decreases as the birth weight increases<sup>(15)</sup>.

After birth, the neurobehavioral analysis of infants, especially PTNBs, who already have a developmental and growth deficit compared to full-term infants, is the first opportunity to understand their different interaction with the early extrauterine environment<sup>(16)</sup>.

Although the incidence and severity of neurodevelopmental sequel increase with lower gestational age, even late preterm infants may be impaired. Compared to term-born infants, late preterm infants present gradual school impairments throughout school life<sup>(17)</sup>. Recent evidence involving late preterm children and assessments of control groups at preschool and school age, mainly focusing on cognitive functioning, language learning and academic performance, has identified suboptimal outcomes in areas such as executive function, short-term verbal memory, literacy skills, attention and processing speed<sup>(18)</sup>.

It is important to highlight that most infants need a period of hospitalization, and prematurity is the main reason for this<sup>(19)</sup>. During this time, they are submitted to several routine procedures, one of which is daily body weight check. Even though it is a quick procedure, it is notorious to observe the disorganization and stress of NBs removed from their incubator or warm lap, undressed and placed on a hard and cold surface that is the anthropometric scale.

In the present study, it was observed that the number of infants who showed signs of stress (withdrawal) was higher during traditional weight check than humanized body weight check, thus responding to the study hypothesis. These most expressive negative neurobehavioral responses were sudden movements, scares, tremulousness, finger splays, strained fussing or crying/restlessness and irritability.

In the same way as this research, one study found a higher frequency of signs of withdrawal in PTNBs during routine bathing compared to humanized bathing. This may be explained by the excessive handling required for body hygiene associated with PTNB immaturity. This finding encourages reflection on the performance of health professionals in the form of their assistance, with adaptations, understanding of the autonomous, motor and states systems, and respect for the rhythm and neurobehavioral signals presented by PTNBs<sup>(15)</sup>.

Contrary to our findings, a study with 11 infants indicates that even wrapping the NB in the towel was not enough to avoid stress in 35-week PTNB submitted to the weighing procedure. This is explained by the fact that immaturity requires, in addition to respectful and delicate care, also a controlled environment<sup>(20)</sup>.

The high level of stress present in the face of so many interventions in PTNBs causes health damage, such as delay in their growth and development, up to permanent long-term consequences, such as alteration in the Central Nervous System, involving brain organization, also having correlations with epigenetic alterations<sup>(19)</sup>.

As highlighted in a study on neonatal neuroprotection, each experience that a child enjoys or suffers in the NU is fed into their growth, and is expressed in their emotions, in their cognition, in sociability and in communication<sup>(17)</sup>.

PTNBs have a Central Nervous System that is not yet fully able to deal with stimuli from the extrauterine environment, which are necessary to guarantee their survival; as a result, they find themselves in a vulnerable situation. Thus, the NICU should be a place that avoids, as much as possible, situations that trigger unnecessary negative stimuli, such as high light and excessive noise production or frequent handling that interrupts rest periods, aiming to reduce the risks to this population through the optimization and adaptation of neonatal care<sup>(5)</sup>.

In this sense, neonatal hospitalization represents a major challenge for professionals, since the environment of a highly complex NU is one of intense pressure and stress, consequently interfering with the organization of PTNBs, either by the environment itself or by the routine of care practices. Improving the quality of practices within the NICU, through humanization, is essential for the survival and neuroprotection of these individuals<sup>(21)</sup>.

Therefore, in this study, the signs of approach had a significant difference between the weighing. The parameters with more

inequality were stable skin color, tucking, relaxed face, coordinated movements and calming easily, being more present in humanized body weight check than in traditional body weight check, making the procedure that less disorganizes the infants and makes them more comfortable. These approach signals are considered positive signs, indicating a balance of external stimulation on the PTNB's body<sup>(22)</sup>.

The values that demonstrate the impact of one body weight check in relation to the other are the median and percentiles, represented in Table 4. These values are higher in the signs of withdrawal in traditional practice, indicating a larger sample of PTNBs that showed negative responses. These results indicate that, during traditional weight check, PTNBs demonstrate a high level of stress, as well as the disorganization of their subsystems.

Regarding the approach signs, the median and percentiles found in humanized body weight check, represented in Table 4, are higher than in the traditional one, indicating that this practice presented a larger sample of the population that had positive signs as a response. This fact indicates that the procedure caused PTNBs a lower level of stress and disorganization of their states.

Finally, it is understood that these infants express themselves through behavioral responses; therefore, the assessment of these signals to the stimuli is extremely important so that there is no overload of stress and disorganization of the states and, in the long term, problems in the Central Nervous System. Thus, qualified nurses contribute to the neuroprotection of PTNBs by interpreting responses and performing good practices during care<sup>(15)</sup>.

It is necessary to emphasize that the lack of publications that investigate the neurobehavioral signs in this clientele makes it difficult to confront the findings, but reinforces the pioneering of this study.

### Study limitations

Considering that the practice of humanized body weight check requires a more time-consuming and laborious handling, compared to traditional weight check, the limitation of this study is the fact that it was carried out in only one center, and there may be variations in results in other realities. However, we can consider as a pilot, which can be replicated in other realities, to search for more generalizable data. A possible limitation was the difficulty of calculating a random sample due to the fact that the study scenario is a unit with variable flow of participant hospitalization. It is believed that the present study adopted the necessary procedures to reduce the possibilities of vices, such as the adoption of a trained team, according to ministerial

protocols. Also, because it is a sample composed of PTNBs who participated in the two proposed interventions, it is believed that it contributes to reducing the possibilities of bias.

### Contributions to health

The research provides an assessment between two neonatal techniques, indicating a better performance of humanized weighing compared to traditional weighing, with evident benefits for NBs, as it exposes NBs to less stress factors and consequent reduction of signs of withdrawal. The research may raise new discussions to indicate the technique in ministerial manuals and service protocols aimed at low-weight/preterm neonatal clients.

Thus, the study clearly brought contributions: to research, through the results exposed on the topic addressed, adding an increase in data on this little explored field of health, thus expanding the scientific evidence and reducing existing gap on the subject in question; to education, through the theme visibility this study will bring to academics, residents and graduate students about the importance of a humanized technique and its impact on PTNBs' health; and for care, contributing to the training of professionals and preparation of clinical protocols to be applied with greater safety in the NU, thus improving quality of care for PTNBs and reducing long-term complications.

### CONCLUSIONS

The study addressed PTNB's body weight check as a theme, bringing into question two types of weighing techniques (traditional and humanized), with the central objective of assessing the neurobehavioral signs of PTNBs submitted to these two procedures, seeking to describe these signs and compare the frequency presented by the population during the two weighing.

It could be seen that the approach signs found in humanized body weight check are relatively greater than in traditional body weight check, portraying a greater potential for organizing the subsystems and a greater tolerance for the type of procedure, which brings greater benefits to this population. In traditional weight check, a greater total of signs of withdrawal was observed than in a humanized way, implying an imbalance of subsystems and an increase in PTNBs' stress level.

In this regard, it is necessary to foster discussions on this subject, so that institutional protocols can take into account the evidence produced and for this practice to be exercised in the health units' routine, especially within a NICU.

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