

Handling of preterm infants in a neonatal intensive care unit

A MANIPULAÇÃO DE PREMATUROS EM UMA UNIDADE DE TERAPIA INTENSIVA NEONATAL

LA MANIPULACIÓN DE PREMATUROS EN UNA UNIDAD DE CUIDADOS INTENSIVOS NEONATALES

Fabíola Lima Pereira¹, Fernanda dos Santos Nogueira de Góes²,
Luciana Mara Monti Fonseca³, Carmen Gracinda Silvan Scochi⁴,
Thaíla Corrêa Castral⁵, Adriana Moraes Leite⁶

ABSTRACT

While hospitalized in neonatal units, preterm infants undergo various manipulations and procedures that have negative health consequences. The aim of this study was to describe the manipulations that preterm infants are subjected to over a 24-hour period in a neonatal intensive care unit (NICU). An observational, descriptive, exploratory study was conducted with 20 preterm infants who were filmed continuously in a NICU over a 24-hour period from September 2008 to March 2009. Preterm infants were subjected to an average of 768 manipulations and 1341 procedures. The average duration of the manipulations over the 24-hour period was 2 hours and 26 minutes. Each manipulation included an average of 2.2 procedures, most occurring during the morning shift. Individual manipulations accounted for 65.6% of all manipulations, and most manipulations lasted less than a minute. The results of this study show that preterm infants in the NICU underwent an excessive number of manipulations over the 24-hour period evaluated.

DESCRIPTORS

Infant, newborn
Infant, premature
Intensive Care Units, Neonatal
Neonatal nursing

RESUMO

Os prematuros são submetidos a diversas manipulações e procedimentos durante internação em unidades neonatais, com consequências deletérias para a saúde. O objetivo do presente estudo foi descrever a manipulação a que são submetidos os prematuros durante as 24 horas em uma unidade de terapia intensiva neonatal (UTIN). Estudo observacional, descritivo, exploratório, realizado com 20 prematuros, filmados continuamente por um período de 24 horas, de setembro de 2008 a março de 2009 numa UTIN. Os prematuros foram submetidos a uma média de 768 manipulações e 1.341 procedimentos. A manipulação durou em média 2 horas e 26 minutos em um período de 24 horas. Cada manipulação agrupou uma média de 2,2 procedimentos, a maioria no turno matutino. As manipulações isoladas representaram 65,6% do total de manipulações e a maioria teve duração inferior a um minuto. Conclui-se que nas 24 horas avaliadas, os prematuros foram submetidos a um excesso de manipulações na UTIN.

DESCRIPTORIOS

Recém-nascido
Prematuro
Unidades de Terapia Intensiva Neonatal
Enfermagem neonatal

RESUMEN

Los prematuros son sometidos a diversas manipulaciones y procedimientos durante su internación en unidades neonatales, con consecuencias perjudiciales para su salud. El objetivo del presente estudio fue describir la manipulación a la que los prematuros son sometidos durante 24 horas en una Unidad Cuidados Intensivos Neonatales (UCIN). Estudio observacional, descriptivo y exploratorio realizado con 20 prematuros, que fueron filmados de forma continua durante 24 horas, de septiembre del 2008 a marzo del 2009 en una UCIN. Los prematuros fueron sometidos a un promedio de 768 manipulaciones y 1341 procedimientos. La duración promedio de la manipulación en 24 horas fue de 2 horas y 26 minutos. Cada manipulación tuvo un promedio de 2,2 procedimientos, la mayoría en el turno matutino. Las manipulaciones individuales representaron el 65,6% del total de manipulaciones y la mayoría de las manipulaciones duró menos de un minuto. Se concluye que, en las 24 horas evaluadas, los prematuros fueron sometidos a un exceso de manipulaciones en la UCIN.

DESCRIPTORIOS

Recién nacido
Prematuro
Unidades de Cuidado Intensivo Neonatal
Enfermería neonatal

¹MS, RN, Neonatal Intensive Care Unit in the Clinical, Hospital of the School of Medicine of Ribeirão Preto, University of São Paulo, Ribeirão Preto, SP, Brazil. biolalpereira@yahoo.com.br ²PhD, RN, Associate Professor, Department of General and Specialty Nursing, Ribeirão Preto College of Nursing, University of São Paulo, Ribeirão Preto, SP, Brazil. fersngoes@eerp.usp.br ³PhD, RN, Associate Professor, Maternal-Child and Public Health Nursing Department, University of São Paulo, Ribeirão Preto, SP, Brazil. lumonti@eerp.usp.br ⁴PhD, RN, Professor, Maternal-Child and Public Health Nursing Department, University of São Paulo, Ribeirão Preto, SP, Brazil. cscochi@eerp.usp.br ⁵PhD, RN, Adjunct Professor, College of Nursing, Federal University of Goiás, Goiânia, GO, Brazil. thaccastal@gmail.com ⁶PhD, RN, Associate Professor, Maternal-Child and Public Health Nursing Department, University of São Paulo, Ribeirão Preto, SP, Brazil. drileite@eerp.usp.br

INTRODUCTION

Technological advances in neonatal intensive care units (NICUs) have contributed to the increased survival of preterm infants (PTIs). However, factors such as the increase in the amount of equipment and number of invasive procedures, the constant need for light, the presence of ambient noise and the required excessive manipulation during care have resulted in a number of adverse effects that trigger changes in the development of neonates, especially in PTIs⁽¹⁻²⁾.

A NICU environment is considered very different from the womb. In the womb, the infant is surrounded by a heated liquid and is contained by the uterine wall, maintaining a sensation of comfort and security. However, upon being born prematurely, the PTI is placed in an incubator in a position that favors manipulation, with its arms and legs extended, a fact that does not help in its organization. Furthermore, there is frequent contact that is generally intrusive, in which the manipulation is focused on the physiological recovery of the PTI. The few affectionate interventions generally come from the parents.

Manipulation can be defined as physical interventions intended to provide patient monitoring, therapy and care⁽³⁾. Some authors define episodes of manipulations as any care that results in clinical stress for the infants⁽⁴⁻⁵⁾. In a study conducted in Brazil, the authors reported that the noise caused by manipulating the infant results in behavioral modifications and stress⁽⁵⁾. Thus, considering the developmental care provided to the infant, the concern shown for excess manipulation of this population segment in neonatal units is remarkable.

Several studies have focused on characterizing the reactivity of newborns to manipulation and their responses to intervention protocols^(1, 4-13). In general, some studies have methodological limitations (e.g., small sample size, use of secondary data, lack of a filming protocol)^(4-7,9,11), but they show that there are excessive manipulations, reaching 18% of the total study period, especially in PTIs with gestational ages less than 30 weeks, in whom physiological changes resulting from the manipulations have been demonstrated⁽⁷⁾.

To improve the quality of infant care, it is imperative that developmental care, as a philosophy for care, be re-examined in terms of the relationship between the infant, the family and those who provide the care. Among the various developmental care strategies, grouping care is aimed at providing more rest for the infant by minimizing manipulations^(12, 14); thus, performing fewer manipulations should decrease the infants' energy expenditures and stress⁽¹⁵⁾.

Prematurity predisposes the infant to difficulties in adapting to life outside the uterus due to their anatomical

and physiological immaturity. Due to the high incidence of risks to which children are exposed in the process of growth and development, they require specialized care, which should focus on more comprehensive and humanized care that concentrates on the quality of life of both the PTIs and their families⁽¹⁶⁾.

The proper handling of PTIs in NICUs equipped with many technological advancements has been the focus of many governmental⁽¹⁵⁾ and international⁽¹⁷⁾ agencies, which have concentrated on proper development and a balance of the infant's biological, environmental and familial needs⁽¹⁵⁾.

We identified 10 studies that have investigated infant manipulation, four of which^(1,4-7) measured the nature and frequency of the manipulation and three of which⁽⁸⁻¹⁰⁾ evaluated the implementation of a protocol, such as minimal touch, kinesthetic stimulation and gentle touch. The remaining three studies⁽¹¹⁻¹³⁾ addressed the pain to which the infant was subjected when manipulated.

Notably, studies that have been published in the last decade raise questions about the developmental care of PTIs as they implement care protocols in search for infant responses to the implemented interventions. It is believed that the characteristics of these studies are justified by the changes that have occurred in neonatal care during this period. The care aimed at the biological recovery of the PTI has been transformed to become care to support their development and has also become centered on the family⁽¹⁶⁾.

Despite all efforts to assist these infants and their families based on developmental care, the reality is far from what had been hoped. In clinical practice, PTI manipulation is still occurring at a high frequency in the NICU, and not all of the professionals who work directly or indirectly with these babies practice grouping of care.

Given the changes in care, it is necessary to evaluate PTI manipulation to provide grants for the reorganization of neonatal care that is aimed at investigating strategies that are effective in reducing PTI manipulation and that are focused on developmental and humanized care.

The aim of this research is to describe the type, frequency and duration of manipulations that PTIs receive over a 24-hour period in a NICU.

METHOD

This observational, descriptive and exploratory study was performed from September 2008 to March 2009 on PTIs admitted to a NICU at a university hospital in the state of São Paulo, Brazil. This hospital is a tertiary reference center for perinatal care and other specialties. In total, 21

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beds are available in its NICU and 27 beds in its intermediate care unit.

The study included 20 PTIs who met the following inclusion criteria: at least one day old, no neurological impairments, not under contact precautions, not taking opioid and sedative medications, not in immediate pre- or post-operative preparations and not in humidified incubators, aiming for the best film quality.

The project was approved by the hospital's Committee for Ethics in Research (Letter No. 2247/2008 CEP/SPC), and after consent was given by the mother or guardian, the infant was filmed for 24 hours using three mini CD Color VR-3256 NTSC DC12V 120mA digital cameras, with three video channels and one audio channel, which were attached to a Pentium 4, 2.0 GHz PC with 17" Philips monitor and an external video card. A Digital Video Surveillance System[®] was used to capture images. The cameras were installed in the following positions: at the head of the PTI, at the feet of the PTI and on a pedestal beside the incubator.

Based on a previous study, a manipulation was considered any procedure performed on the PTI, which could include therapeutic, care or monitoring procedures⁽⁷⁾. The procedures were recorded as starting when the PTI's incubator door was opened and ending when the last procedure was performed and the caregiver closed the incubator door. Thus, the manipulations could occur as individual manipulations, i.e., when only one procedure was performed per opening and closing of the door, or grouped manipulations, when two or more procedures were performed during this process.

The type, frequency and duration of each manipulation were measured. The frequencies of manipulations according to work shifts were also recorded: shift 1 (7:00 to 12:59), shift 2 (13:00 to 18:59), shift 3 (19:00 to 23:59) and shift 4 (24:00 to 6:59). The first two shifts represent, respectively, the shifts of the morning and afternoon nursing staff, and the last two shifts represent the night nursing staff.

The filming for each PTI occurred separately over a consecutive 24-hour period, starting at 12:00 on one day and ending at 12:00 on the next day. Images were recorded using the software Digital Video Surveillance System at high speed (30 frames per second). First, the images were observed by the researcher and the research assistant at this fast speed, and the approximate hour, minute and second of each manipulation were recorded. Then, following this first analysis, the *avi frame changer* option on the program *Avifrate* was selected, allowing the researchers to modify the execution speed of the image. In general, the images were changed to the rate of 5 frames per second. At the modified speed, the researchers again analyzed the periods during which these manipulations occurred at the slower speed to record the exact time (hour, minute and second) that the procedures started and ended.

A manipulation could occur as an individual manipulation (when a procedure was performed in isolation)

or as a group of manipulations (when various types and categories of procedures were conducted during the manipulation).

Thus, the time variable was analyzed by observing the durations of the individual manipulations that occurred in isolation or the durations of those that occurred as a group. In the latter case, each duration of manipulation extended from the start of the first procedure until the completion of the last procedure on the infant and the door of the incubator was closed.

After all of the manipulations were identified for each PTI, the procedures performed were identified, and whether or not they were individual manipulations was recorded. To analyze the frequency at which the 51 different procedures were performed on the PTI, each procedure was coded and numbered sequentially from 1 to 51, as it appeared in the images.

When procedures occurred simultaneously, i.e., by grouping care, all of the codes were recorded in a sequential manner as they occurred during that manipulation. This procedure attempted to identify which manipulations occurred most frequently and to analyze the variability of these procedures and their distribution in both groupings and time periods.

Two investigators independently performed the film analysis; the investigators had an overall concordance of 92%, as calculated using Kendall's test. The total time for the loss of image was 5 hours, 19 minutes and 50 seconds for each camera, for a combined 15 hours, 58 minutes and 30 seconds of the 1440 hours, which is equivalent to 1.2% of total image time. The losses occurred for the following infants: infant 5 had a loss of 12 min and 13 seconds; infant 7 had a loss of 3 minutes and 50 seconds; infant 11 had a loss of 22 minutes and 11 seconds; infant 12 had a loss of 3 hours, 54 minutes and 5 seconds; and infant 14 had a loss of 40 minutes and 54 seconds.

The losses occurred because of a variety of issues, including power loss, the loss of a camera signal that was not immediately repositioned, the detachment of the cables connected to the computer and the instability of the equipment. Because we did not have wireless cameras, it was often necessary to exchange wires that were damaged as the cameras were moved around while filming the different PTIs.

The total time required for filming and image analysis was 10 months. Video was collected from October 2008 to March 2009, and the film analysis occurred between October 2008 and August 2009. The recorded data were entered into Excel[®] spreadsheets and were then transferred to the software Epi Info[®] for descriptive statistical analyses, which calculated absolute and relative frequencies, means, medians and standard deviations of the variables studied.

RESULTS

Of the 20 PTIs enrolled in the study, 65% were male, and 75% were delivered via cesarean sections. The average birth weight was 1160.7 g \pm 344.8 g (ranging from 645 g to 1,830 g). The average PTI gestational age was 29 weeks and 6 days \pm 13 days (ranging from 28 weeks and 6 days to 33 weeks). The average length of stay in the NICU was 14 days \pm 11 days (ranging from 2 days to 43 days).

The 20 PTIs underwent a total of 768 manipulation and 1,341 procedures, and each manipulation had an average of 2.2 procedures. The overall mean number of manipulations was 38 (\pm 13.2), with a median of 38.4 manipulations. The overall mean number of procedures was 67 procedures per PTI. The frequency of the manipulations per PTI ranged from 14 (1.8%) to 71 (9.7%) episodes, and the frequency of procedures ranged from 59 (4.55%) to 109 (8.1%) in the 24-hour period. Table 1 shows the frequency and percentage distributions of the manipulations and procedures performed on each PTI in the NICU over the 24-hour period.

Table 1 – Frequency distribution of the manipulations and procedures performed on PTIs in the NICU over a 24-hour period.

PTI code	Manipulations (f)	%	Procedures (f)	%
1	71	9.7	109	8.1
2	24	3.1	41	3.1
3	54	7.0	75	5.6
4	35	4.6	52	3.8
5	38	4.9	64	4.8
6	53	6.9	101	7.5
7	48	6.2	92	6.9
8	43	5.6	85	6.3
9	27	3.5	59	4.4
10	40	5.2	72	5.4
11	34	4.4	62	4.6
12	20	2.6	42	3.2
13	38	4.9	58	4.4
14	42	5.6	74	5.5
15	39	5.1	62	4.6
16	56	7.3	78	5.8
17	14	1.8	34	2.5
18	34	4.4	67	5.5
19	26	3.4	55	4.0
20	32	4.2	59	4.5
Total	768	100	1341	100

The mean duration of the total time for which the PTIs were handled over the 24-hour period was 2 hours, 26

minutes and 33 seconds, in which the longest time was 5 hours, 9 minutes and 9 seconds and the shortest time was 53 minutes and 15 seconds.

When manipulations were performed in groups, for 6 PTIs, the minimum interval between manipulations was zero because the manipulations were consecutive, whereas the interval between the other manipulations ranged from 4 to 57 seconds. However, when performed individually, i.e., only 1 procedure was performed during the process of opening and closing incubator door, the maximum interval between end of a manipulation and the start of the next manipulation ranged from 30 minutes and 12 seconds to 5 hours, 16 minutes and 18 seconds.

Table 2 shows the frequency of manipulations according to the different time intervals.

Table 2 – Distribution of the frequencies of the duration of manipulations of PTIs in the NICU over a 24-hour period.

Interval (minutes)	Manipulations (f)	Manipulations (%)
<1	321	41.6
$\geq 1 \leq 2$	99	12.9
$> 2 \leq 3$	71	9.3
$> 3 \leq 4$	62	8.1
$> 4 \leq 5$	42	5.4
$> 5 \leq 6$	30	3.9
$> 6 \leq 7$	25	3.3
$> 7 \leq 8$	25	3.3
$> 8 \leq 9$	19	2.5
$> 9 \leq 10$	11	1.4
$> 10 \leq 11$	7	0.9
$> 11 \leq 12$	10	1.3
$> 12 \leq 13$	8	1.0
$> 13 \leq 14$	5	0.4
$> 14 \leq 15$	3	0.7
> 15	30	3.9
Total	768	100

As shown in Table 3, of the 768 manipulations, 504 (65.6%) were performed as individual manipulations, i.e., only 1 procedure was performed, and 264 were grouped, i.e., 2 to 10 sequential procedures were performed. On average, the staff performed 2.2 procedures per manipulation. The frequency of the manipulations decreased as the number of grouped procedures increased.

Regarding the relationship between the various shifts and the frequency of the manipulations, the first shift had the highest number of manipulations, followed by the second shift. Shift 4, i.e., the second half of the night shift, had the fewest manipulations, as shown in Table 4.

Table 3 – Distribution of the forms of manipulations performed on PTIs in the NICU over a 24-hour period.

PTI Code	Individual	Grouped	Total
1	48	23	71
2	16	8	24
3	35	19	54
4	27	8	35
5	24	14	38
6	36	17	53
7	29	19	48
8	24	19	53
9	18	09	27
10	22	18	40
11	19	15	34
12	9	11	20
13	29	9	38
14	30	12	42
15	31	8	39
16	44	12	56
17	8	6	14
18	22	12	34
19	11	15	26
20	22	10	32
Total	504	264	768

Table 4 – Distribution of frequencies of the manipulations performed on PTIs in the NICU over a 24-hour period according to shift.

Shift	Manipulations (f)	Manipulations (%)
1	230	29.9
2	204	26.7
3	190	24.7
4	144	18.7
Total	768	100

DISCUSSION

Although the humanization of programs designed to care for infants in Brazil have encouraged care strategies that provide for proper development and aim to balance the infant's biological, environmental and familial needs⁽¹⁴⁾, further studies are still necessary to evaluate current and future conditions so that such measures are actually implemented.

Few of the current studies have examined manipulations by themselves, making it difficult to compare data because most of the studies we reviewed were performed outside of Brazil, where the reality of neonatal care is already quite different compared to Brazil.

A study conducted in the state of São Paulo with 9 PTIs admitted to the NICU evaluated the times, frequencies and types of manipulations for 6 hours a day for 17 days. This study reported that the PTIs were handled 45.42 times in 6 hours, or approximately 181.68 times over a 24-hour period⁽¹⁸⁾. Despite the differences between the time periods filmed, in the present study, the PTIs were handled less. However, the number of manipulations was still higher than 1 per hour. Perhaps this quantity is due to the fact that minimal PTI manipulation is one of the strategies that have been widely discussed in the humanization courses focused on PTIs that have been offered in recent years to staff in the unit where this study took place. Because the changes that have been implemented thus far have involved only team awareness, much of this reality still needs to be changed; however, the protocols have yet to be developed and optimized.

Although the data presented here show that there are differences between our study and the above-mentioned study⁽¹⁸⁾, the manipulations are still excessive in quantity compared to the reality seen in centers in foreign countries, in which the measures for developmental care have already been being applied for more than two decades. However, current studies no longer attempt to quantify the number of manipulations but instead quantify the behavioral responses of PTIs before these protocols were implemented – protocols that include minimal PTI manipulation as one of their strategies, among many others.

In relation to the durations of the manipulations to which PTIs were exposed, one study reported that 5 PTIs (27 to 35 weeks gestation) were handled 18% of the time over a 24-hour period⁽⁶⁾. Another study also measured the manipulations that occurred for 7 PTIs (26 to 31 weeks) over a consecutive 24-hour period via filming⁽¹⁾. On average, the manipulations in these studies lasted 72 minutes and 12 seconds and 40 minutes and 36 seconds over 24 hours, respectively. Importantly, both studies measured only the total time of manipulation, without reporting the minimum and maximum of each PTI.

The present study highlights the large number of manipulations that last for less than a minute. This situation was also identified in the previous study that followed 12 PTIs born at less than 32 weeks gestation⁽⁴⁾. The authors noted that there were a large number of manipulations in a short period of time and that 1 infant had more than 15 manipulations within 10 seconds on his/her first day of life⁽⁴⁾.

Unlike most studies on manipulation that try to achieve homogeneity among individuals, PTIs who were only 1 day old were excluded from the sample. This criterion was included because whether the infant requires a high number of manipulations, especially during the first few hours, depends on their clinical condition. Because of this variable, there would be a risk of some infants having many more manipulations than other infants.

Regarding the forms of manipulation in this study, the majority were individual manipulations. There was no routine or established protocol for grouping care in the NICU studied. Moreover, when manipulations were grouped, the procedures were performed randomly, without any attempts to standardize the care or attempts to meet the needs of the PTI.

Minimal manipulation refers to a grouping of care in which the infant is seen as the center of care and requires caregivers to act together, prioritizing the needs of the infant⁽¹⁴⁾. This strategy also focuses on the importance of practicing minimal manipulation and grouping care and the importance of encouraging these procedures within the NICU⁽¹⁹⁾.

Through these studies, we have realized that despite the proactive measures to reduce PTI manipulation, we have not focused on the organization of the manipulations. Individual manipulations for single procedures still represent the majority of manipulations, and when care is grouped together, there is no systematic organization for procedures being performed. Although we consider that PTIs should be recognized as unique individuals in that their care must be individualized, we often do not consider their individuality when adopting care groupings, combining procedures that are highly stressful, painful and unnecessary. As an example of such procedures, changes in the placement of adhesives on the skin and the pulse-oximeter sensor occur simultaneously. Such procedures are grouped for the purpose of reducing manipulation in quantitative terms, but not in terms of the stress caused to the PTI; the authors consider both procedures to be stressful and even painful⁽⁷⁾.

Nurse practitioners have identified excessive manipulation as a causative agent of pain and stress for infants in intensive care, pointing to minimal manipulation as an important strategy for decreasing PTI stress⁽²⁰⁾.

According to some authors, minimum manipulation is effective in promoting the stability and organization of infants, facilitating the energy conservation necessary for their growth and development^(12,14,20). However, there is still no evidence from randomized clinical trials on the effectiveness of grouping care based on the responses of infants admitted to neonatal units⁽²⁰⁾.

With respect to the different work shifts and the frequency of manipulations in both this and previous studies⁽⁶⁾, the daytime shifts performed more manipulations than the nighttime shifts. This observation is explained by the fact that morning and afternoon shifts have more professionals working, especially medical and nursing staff; according to the protocols implemented in the unit, this period is also designated for clinical examinations and the collection of samples for testing.

Regarding the methodology used in previous studies examining manipulation, there are several differences in the time periods observed. Three studies filmed 3 set periods for 1 hour⁽⁸⁾ or 2 hours^(9,10). The filming of infants for

a 24-hour period has also been used in 4 other studies^(1,4-7), 1 of which occurred over different 24-hours periods over a span of 4 days⁽⁶⁾. In another study, the filming occurred within the first 3 days of the infant's life, in which the start time of the filming varied⁽⁴⁾.

The limitations of this study include its small sample size; however, recruiting patients in this population has also been difficult in previously published studies^(1,4-6,8-10) and often requires multicenter studies. There were difficulties in selecting patients due to the use of humidified incubators, the instability of the PTI and the use of sedatives or opioids. Notably, in infants who were in phototherapy, the light often impeded the analysis at times because of the positioning of the cameras, a situation that could not have been predicted by the researcher.

The short time in which the PTIs were filmed is another limitation of the study, illustrating only a part of the exposures they are subjected to during their hospitalization in the neonatal unit.

The option to film the PTIs for 24 consecutive hours, as employed in previous studies^(1,4-7), was subject to operational issues such as power outages and disconnection of power cords and communication cables from the computer. Thus, we suggest that future researchers use wireless devices to prevent interruptions in filming and to facilitate the installation of the equipment, as mounting the equipment was very time consuming due to the need to connect these wires to the computer.

Despite these limitations, the results allowed us to map the manipulation patterns for PTIs in the NICU studied, which may assist in the development of protocols for the care of these infants and for conducting future research aimed at reducing manipulations in this vulnerable population.

CONCLUSIONS

The results of this study indicate that premature infants at the location studied are subjected to excessive manipulation during hospitalization. This result prompts the need for a critical evaluation of the care provided to this population, specifically with regard to decision making for whether and when to perform procedures and manipulations for these children during therapy.

These data also highlight the need for studies that examine the quality of the manipulations performed and the effectiveness of the interventions included in developmental care, such as the grouping of care, based on the tolerance of the infant.

Studies that explore the behavioral and physiological reactivity of PTIs to the frequent manipulations to which they are exposed in neonatal units should also be conducted.

Hopefully, these results will aid in the acquisition of the funds required to implement changes in health care

practices through the use of effective strategies to reduce PTI manipulation, thus contributing to the quality of care and quality of life of these children and their families.

Critically assessing and managing PTI manipulation under different care situations should be the motivation for conducting future studies.

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