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Application of TIMP in the hospital environment: a reality for early intervention in preterm infants

Aplicação do TIMP no ambiente hospitalar: uma realidade para intervenção precoce em prematuros

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Abstract

Background: Increased survival of preterm infants is associated with greater chances of delayed neuromotor development, making early identification of these risks crucial to optimizing interventions and improving prognosis. However, it is not routine in all hospitals. **Aim:** To justify the need for early screening of premature newborns without comorbidities through a validated and standardized assessment that is viable for this purpose. **Methods:** A cross-sectional and prospective study was conducted with 108 newborns (55 newborns and 53 preterm infants) in two Brazilian public hospitals. Newborns were evaluated using the TIMP scale. The newborns were divided into two groups: G1 (PTRN) with a gestational age of less than 37 weeks of birth and G2 (RNT) with a gestational age of more than 37 weeks of birth. Those with genetic syndromes or severe neurological changes were excluded. **Results:** PTNBs had lower anthropometric and APGAR measurements. Regarding motor performance, the raw TIMP score was significantly lower in PTNB (45.01 ± 14.33) compared to RNT (66.8 ± 22.2), with an average Z-score of -0.97 ± 0 .65 for PTNBs and -0.24 ± 1.02 for RNTs, p<0.001. **Conclusion:** Early assessment of motor performance in preterm infants proved to be essential for detecting delays even in the absence of comorbidities and assessment using TIMP demonstrated to be a viable tool in this screening in neonatal units.

Keywords: Prematurity; Psychomotor Performance; Child Development; Premature.

Resumo

Introdução:O aumento da sobrevida dos RNPT está associado a maiores chances de atraso no desenvolvimento neuromotor, sendo crucial a identificação precoce desses riscos para otimizar intervenções e melhora prognóstica. Entretanto não é rotina em todos os hospitais. **Objetivos:** Fundamentar a necessidade de triagem precoce de RNs prematuros sem comorbidades por meio de uma avaliação validada e padronizada e que seja viáveln para esse fim. **Métodos:** Foi conduzido um estudo transversal e prospectivo com 108 recém-nascidos (55 RNT e 53 RNPT) em dois hospitais públicos brasileiros. Os recém-nascidos foram avaliados com a escala TIMP. Os RN foram divididos em dois grupos: G1 (RNPT) com idade gestacional inferior a 37 semanas de nascimento e G2 (RNT) com idade gestacional superior a 37 semanas de nascimento. Excluíram-se aqueles com síndromes genéticas ou alterações neurológicas graves. **Resultados:** Os RNPT apresentaram menores medidas antropométricas e APGAR. Quanto ao desempenho motor, a pontuação bruta do TIMP foi significativamente menor nos RNPT (45,01 ± 14,33) em comparação aos RNT (66,8 ± 22,2), com Z-score médio de -0,97 ± 0,65 para os RNPT e -0,24 ± 1,02 para os RNT, p<0,001. **Conclusão:** A avaliação precoce do desempenho motor em RNPT demonstrou ser essencial para a detecção de atrasos mesmo na ausência de comorbidades e a avaliação por meio da TIMP demonstrou ser uma ferramenta viável nesta triagem em unidades neonatais.

Palavras-chave: Prematuridade; Desempenho Psicomotor; Desenvolvimento Infantil; Prematuro.

INTRODUCTION

The increased survival of preterm newborns (PTNB) is a result of the advances in prenatal, perinatal and neonatal care, however, these individuals are more likely to have neurodevelopmental delays, such as developmental coordination disorders, cognitive and communication difficulties[1-3]. The identification of risk factors is thereby essential, making early intervention feasible, and optimizing neural plasticity[4-6] .

Prematurity may be associated with external prenatal factors, such as socioeconomic conditions and low education, hindering the access of pregnant women to prenatal care as well as to an adequate nutrition[7]. It may also be correlated with postnatal variables, such as birth weight, growth percentile and corrected age, which may interfere with the motor profile of the NB[8-10].

Prematurity, especially regarding infants born before 36 weeks of gestation can be an independent risk factor for delayed neurological and motor development. Studies[7,8,10] indicate that these infants are more vulnerable due to the critical stage of brain development in the last weeks of gestation. As a result, they often present suboptimal neurological scores throughout their first year of life. A close monitoring of these individuals, performing specific examinations, can identify delays early on. Thus, therapeutic interventions, such as physiotherapy, are fundamental to minimize future deficiencies and improve long-term outcomes[11].

The assessment and identification of a NB with a developmental delay is complex and requires the use of appropriate tools[1]. The Test of Infant Motor Performance (TIMP) is a clinical instrument that is highly sensitive to small alterations in motor performance, with good clinical applicability and evaluative validity, useful to document developmental changes and predict motor outcomes[12-14].

Globally, TIMP has been used to identify motor delays, measure early intervention outcomes, and to provide parental education on child motor development[15]. The earlier differences or abnormalities are detected in the expected motor milestones, the earlier the intervention can be implemented[16]. With that being said, this early screening in neonatal hospitalizations is not yet routine and the focus for physiotherapeutic discharge often considers only severe neurological alterations, presence of comorbidities and respiratory stability, where the existence of prematurity alone usually does not guarantee the continuity of care due to the lack of adequate screening. Therefore, the present study aimed to analyze the motor development profile of term and preterm newborns without comorbidities and use these data to confirm the demand for early screening with the guarantee of a longitudinal follow-up.

METHODS

This study is characterized as a cross-sectional and prospective study, carried out with preterm newborns (PTNB) and term newborns (TNB) hospitalized in the Joint Accommodation (JA) of two Brazilian public hospitals in the South and Southeast regions.

The data collection was performed ensuing the approval by the Research Ethics Committee of the Universidade Federal de Santa Catarina, protocol No. 08989819.2.0000.0121, and from the Universidade Ibirapuera, protocol No. 55509021.1.0000.5597. The staff responsible for the JA was invited to participate in the present research and was informed about all procedures, providing the acceptance of the informed consent form (ICF) terms.

The professionals in charge were then instructed about consulting electronic health records, obtaining information about pregnancy as well as childbirth. Furthermore, it was explained how the motor performance assessments would be carried out and the need for image recording on the procedure.

The NB were divided into G1 for preterm infants (PTG), comprising PTNB born before 37 weeks, and G2 for the term group (TG), considering NB born at more than 37 weeks of gestational age. It was included in the study NB with gestational age greater than 34 weeks at the time of evaluation, presenting spontaneous breathing in room air and using the neonatal cots at the days of data collection. NB with genetic syndromes, congenital malformations, osteomioarticular disorders, sensory deficiencies associated with hearing and visual impairment or presenting neurological alterations such as seizures were excluded from the present study, in order to reach a greater sample interference from the prematurity factor than from the comorbidities that are known to lead to the worsening of neurodevelopmental outcomes.

All evaluations were conducted by three researchers trained to apply the scale, in a space that was bright, quiet and at room temperature, close to the NB's cots. The recording was performed with the Smart 4K Ultra HD digital camera and camcorder, XTRAX®.

The Test of Infant Motor Performance (TIMP) version 5.1® used in this research evaluates the motor development of newborns up to 17 weeks of corrected gestational age, consisting of 13 observable items and 42 elicited items, allowing the evaluator a quick and accurate assessment[13].

The NB, when presenting the behavioral state 3,4 or 5 of the Neonatal Behavioral Assessment Scale, described in the TIMP instructions, would be able to participate on the test. In preparation for the decubitus changes, the NB was filmed for 2 minutes wearing only diapers. First, the adopted posture was the supine to sitting position, subsequently using supine to lateral decubitus, then, prone and standing. In addition to the postural alterations, resources such as a red ball and a rattle were employed to stimulate the visual and auditory part.

Following the end of the data collection, a blind evaluator, physiotherapist, pediatric specialist that was qualified to apply the TIMP scale received the footage, scoring it without prior identification of the gestational age or the NB classification as part of G1/G2.

The Minitab® 14 statistical package was used for the data analysis. Statistical significance was considered at p<0.05. To test the normality of the data, the Shapiro Wilk test was implemented, whereas for comparing the groups, the unpaired t-test or the Mann Whitney test was applied, depending on the data distribution. Pearson's correlation coefficient was used in the correlation analysis. Finally, the present research complied with the ethical principles established by the Declaration of Helsinki.

The sample calculation was accomplished using the Minitab 14 program. After performing the calculation by choosing the independent samples t-Test (difference between two means) with a 0.50 difference in the TIMP Z-Score, significance level (α) of 5% (p = 0.05), 90% power (1-β) and a standard deviation of the Z-Score of 0.75 ensuing a battery of 13 pilot tests, where the minimum sample considered herein was 49 NB per group.

RESULTS

A total of 108 NB were assessed with the TIMP scale, being 55 TNB and 53 PTNB. Table 1 depicts the characteristics of the evaluated infants.

The results indicate significant differences regarding several variables between the groups of preterm newborns (PTNB) and full-term newborns (TNB). In Table 1, PTNBs presented lower head circumference (28.75 cm) and thoracic (27.50 cm) values when compared to TNBs, which showed values of 34.28 cm and 33.85 cm, respectively. Moreover, PTNBs had a lower birth weight (1820 g) and gestational age (32.90 weeks) than TNBs (3126 g and 38.86 weeks). Apgar scores were also lower for PTNBs at the first and fifth minutes, suggesting a more delicate initial condition when compared to TNBs, with statistically significant differences (p<0.01).

The Table 2 and graphs points out the discrepancy in motor performance between the two groups, as measured by both the raw score and the Z-score of the TIMP scale. The PTNBs obtained a mean raw score of 45.01, significantly lower than the TNBs (66.8), with a p-value of 0.000, confirming the statistical difference. Similarly, the mean Z-score of the PTNBs was -0.97, while the TNBs presented a -0.24 Z-score, also with significance (p<0.000). These data show that PTNBs display a lower motor development in the first months of life than TNBs, reinforcing the demand for specialized monitoring for this population (Figure 1).

DISCUSSION

The results of the present study reveal significant differences between preterm and term newborns in several variables, reflecting the impact of prematurity

Table 1. Characterization of the NB sample.

Variables	Groups		*p-value*
	PTG (n=53)	TG (n=55)	
Head Circumference (cm)	28.75 (± 2.63)	34.28 (± 2.13)	**0.00***
Chest Circumference (cm)	27.50 (± 1.29)	33.85 (± 1.95)	**0.000***
GA (weeks)	32.90 (± 2.55)	38.86 (± 1.01)	**0.000***
Days of age	24 (14 – 44)	1 (1 – 1.5)	**0.01***
Birth weight (g)	1820 (± 456.35)	3126 (± 487.90)	**0.00***
Newborn length (cm)	37 (± 7.70)	49.28 (± 2.62)	**0.00***
Apgar 1'	8 (4 – 9)	9 (7 – 9)	**0.000***
Apgar 5'	9 (6 –10)	10 (9 – 10)	**0.000***

Key: PTG: Preterm group; TG: Full-term group; GA: Gestational age; cm: centimeters; g: grams; * p<0.05.

Table 2. Raw TIMP Score and Z-Score.

Characteristics	PTG (n=53)	TG (n=55)	p-value
Raw TIMP score	45.01 ± 14.33	66.8 ± 22.2	**0.000***
TIMP (Z-score)	-0.97 ± 0.65	-0.24 ± 1.02	**0.000***

Legend: PTG: Preterm group; TG: Full-term group; * p<0.05.

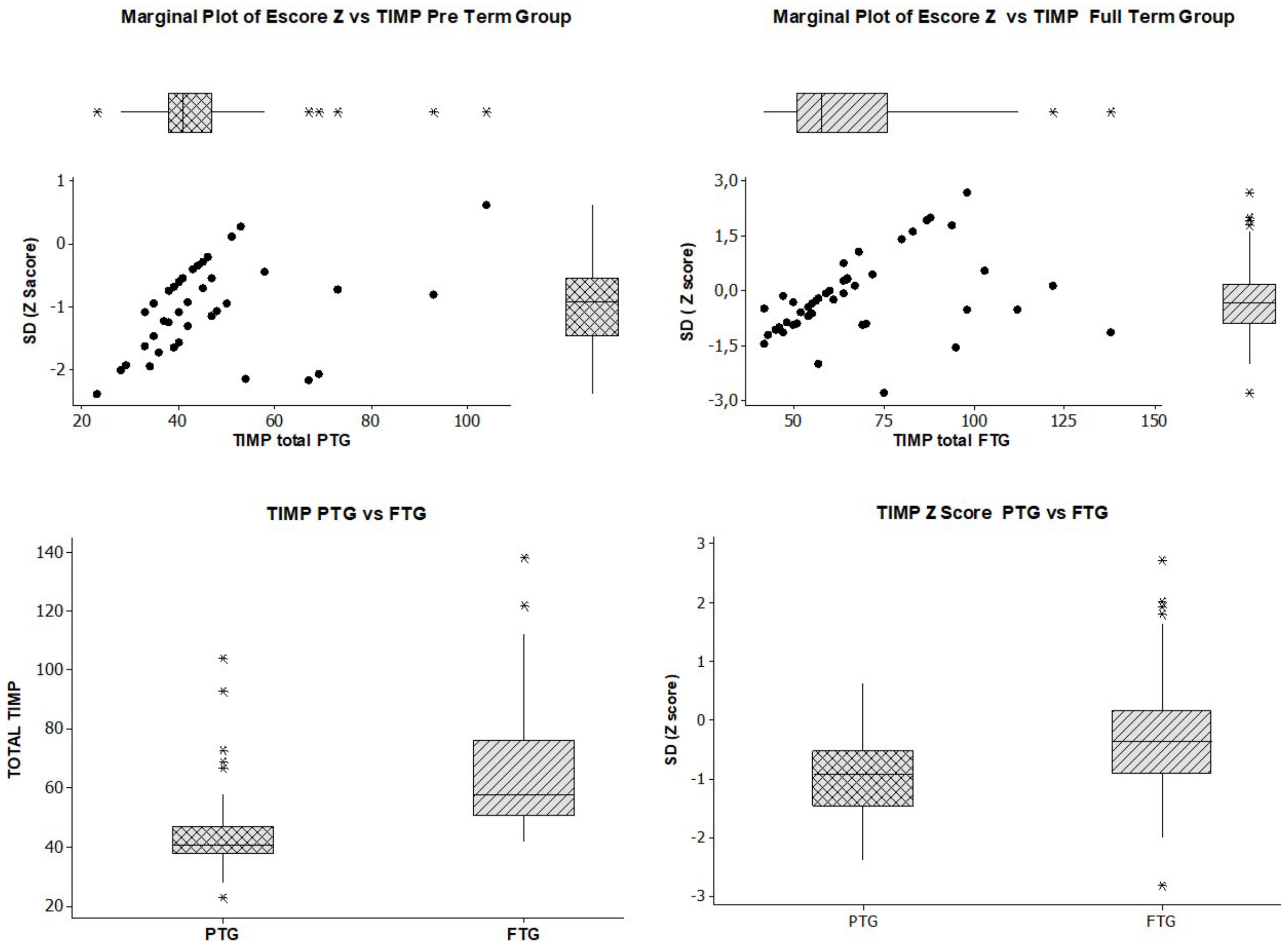

Figure 1. Comparison of the Z-score and the raw TIMP score between groups. PTG= pre term Group. FTG= Full term group. SD= Stand deviation (Z Score).

on early development. Preterm newborns had lower anthropometric measurements when compared to full-term newborns. These discrepancies indicate a slower physical development in preterm infants, who also presented lower Apgar scores, suggesting a higher clinical frailty at birth. Furthermore, the motor performance of preterm newborns, as assessed by the TIMP scale, was lower than that of full-term newborns. Raw scores and Z-scores revealed that preterm infants presented a significant delay in motor development. These results corroborate the importance of early monitoring and interventions, since prematurity directly affects neuromotor development in the first months of life, even in the absence of comorbidities.

The early neurodevelopmental assessment in preterm newborns is crucial for a rapid detection and intervention in potential neurobehavioral delays or impairments. Premature infants have an elevated risk of neurological impairments, such as cerebral palsy and cognitive difficulties, which can affect their quality of life significantly. Studies indicate that instruments such as the Test of Infant Motor Performance (TIMP)[13-15] and the General Movements (GMs) assessment have strong predictive validity to identify neurodevelopmental problems in neonates still in the hospital environment. The implementation of these instruments within the hospital, particularly in the Neonatal Intensive Care Units (NICU), provides for a proactive approach, since interventions can be initiated early, increasing the chances of better long-term outcomes[17,18].

For these assessments to be effective in the hospital setting, it is essential that the healthcare team is adequately trained in the use of tools such as TIMP and General Movements (GMs), being paramount that such evaluations be routinely incorporated into neonatal care practices. Moreover, integrating neurobehavioral assessments with modern monitoring and intervention technologies can optimize the personalization of care, allowing healthcare providers to adjust treatment strategies based on the specific outcomes of each newborn. Systematic reviews and meta-analyses, such as those found in databases like PubMed and Cochrane, emphasize the importance of these practices and offer robust evidence for their implementation, highlighting the demand for continuous research to refine techniques and ensure that the assessments are both effective and minimally invasive for neonates[17].

The neurodevelopment assessment in preterm infants is essential, even in the absence of apparent comorbidities, due to the high risk of neurobehavioral delays and deficiencies that said population faces. Even when preterm infants do not present serious medical conditions, such as intraventricular hemorrhages or bronchopulmonary dysplasia, they are still susceptible to subtle but significant difficulties in motor, cognitive and behavioral development. Studies indicate that, despite the absence of comorbidities, these babies tend to have alterations in development that are not immediately visible, but that can manifest themselves in later stages of childhood, negatively impacting their academic as well as social performance, and the present study shows an increased risk of delay in these infants[18-20].

The implementation of early neurodevelopmental evaluations, namely the Test of Infant Motor Performance (TIMP) and the General Movements (GMs) assessment, is vital to identify these difficulties in advance. These tools allow for the early detection of problems that, while potentially appearing to be mild at first, can worsen if not treated properly. An early assessment facilitates interventions that can improve long-term outcomes, promote healthier and more balanced development, as well as prevent or minimize the impacts of impairments that could go unnoticed in the absence of a detailed and systematic analysis[17-20].

TIMP has specific advantages when applied in the hospital setting before discharge. It is a standardized test that directly evaluates the infant's motor responses to different stimuli and postures, providing a detailed analysis of specific motor skills, such as postural control and antigravity movements. This approach facilitates the early identification of possible motor development delays, simultaneously offering subsidies for the implementation of early interventions, such as motor stimulation programs during hospitalization. This aspect is particularly relevant to improve the motor prognosis of these children[21-24].

Another positive point of TIMP is its adequacy to the hospital context. It can be applied by physiotherapists trained with the use of simple equipment, being sensitive to changes that occur in motor development throughout hospitalization. In addition, the results obtained with the TIMP scale have a high predictive capacity for future motor delays, allowing a more targeted planning for follow-up after hospital discharge. TIMP is especially useful for infants between 32 weeks of corrected gestational age and 4 months of post-term age, covering the critical period for detection and intervention in motor developmental delays[21,25-29].

On the other hand, GM assessments, despite being the gold standard for detecting subtle neurological patterns, are based on passive observations of the newborn's spontaneous movements. In the hospital setting, this can be a limitation, as spontaneous movements may be influenced by medical, environmental or interventional conditions. Furthermore, the GM approach does not describe in detail the specific motor skills that could be directly worked on in interventions, and the training required for the application of this tool is still harder to come by in Brazil than for the TIMP scale, which could be more accessible in the short term for a greater number of professionals. Thus, while GMs play an important role in detecting subtle motor alterations, TIMP presents practical and clinical advantages in the hospital context, being feasible for early interventions and post-discharge care planning[22,26,29].

Therefore, the present study highlights the need to evaluate all preterm newborns still in the hospital environment as well as the need to compare different instruments. The limitations of this study were the use of a single assessment tool and being performed in only 2 medical facilities. Further studies are still necessary to investigate other tools, regarding the feasibility and reliability of other instruments with a multicentric approach.

CONCLUSION

Prematurity is strongly related to delays in child motor development and there is an urgent need to implement routine screenings for the early detection of such impairments, which is not yet a reality in all neonatal units.

TIMP has proved to be a viable tool that healthcare professionals can learn to improve the identification of motor delays and thus be able to direct post-discharge care to minimize the deleterious effects of prematurity.

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Nothing to declare

CONFLICT OF INTEREST

Nothing to declare

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