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# Effects of Yakson Therapeutic Touch and Heel Warming on Pain Caused by Heel Stick Procedure, Vital Signs, and Cry Duration in Full-term Neonates

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**Abstract**

**Background:** Neonates are more sensitive to pain and likely to suffer from its long-term complications. Therefore, various methods including non-nutritive sucking, sensory stimulations, and various supportive interventions are employed to relieve pain in newborns.

**Aim:** This study aimed to compare the effects of Yakson therapeutic touch and heel warming on pain caused by heel stick procedure, vital signs, and cry duration in full-term neonates.

**Method:** This randomized clinical trial was conducted among 78 full-term newborns referred to healthcare centers in Mashhad, Iran, 2017. They were assigned into three groups of Yakson theraputic touch, heel warming using a hot-water bottle with the temperature of 40°C, and control receiving routine care, through randomized block method. Then, vital signs before and after and pain intensity after heel-stick procedure were measured using Neonatal Infant Pain Scale (NIPS). Data analysis was performed using Kruskal-Wallis and Wilcoxon tests in SPSS software, version 16.

**Results:** The study groups were homogeneous considering demographic characteristics. The results of Kruskal-Wallis test showed a significant difference between the groups regarding the mean scores of the NIPS at the post-intervention phase (P=0.02). However, no significant difference was observed between pre- and post-intervention phases in the groups considering respiratory and heart rates. Additionally, cry duration significantly reduced in the group that received Yakson therapeutic touch (P=0.03).

**Implications for Practice:** The use of Yakson therapeutic touch could relieve pain, soothe the neonates, and shorten cry duration in newborns after heel stick procedure. Nevertheless, heel warming only increased up blood flow for easier blood sampling.

**Keywords:** Heel stick, Heel warming, Infant, Pain, Yakson therapeutic touch

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**Introduction**

It is quite a long time that newborns and infants have been crying and those individuals seeing them have been always indifferent and unaware that crying can be considered as a response to pains happening to them (1). According to the literature, autonomic and neural functioning are fully developed in newborns. Therefore, they are able to understand, experience, and even remember pains (2, 3).

Investigations have further revealed that newborns and infants are much more prone to be affected by the negative complications of pain than adults and older children (4). In addition, prolonged and recurrent pains in the neonatal period can lead to relatively permanent changes in the exciting automated systems due to past painful experiences. Ultimately, the most important clinical effects of early pain experience on neonates are poor neurodevelopment, reduced attention span, learning disabilities, and behavioral problems (4).

Additionally, slight and short-term pain-related stress in neonates can contribute to several problems such as hyperdynamic circulation, cor pulmonale, and cardiac dysrhythmia. In this regard, the release of hormones by untreated pains may exacerbate damage, delay wound healing, and consequently increase mortality (4). Moreover, neonatal pain may bring about immediate and short- and long-term harmful effects.

The immediate complications can be in the form of fear, irritability, sleep problems, and nutritional deficiencies. The short-term effects are manifested as delayed wound healing, immunodeficiency, and emotional damage. Eventually, the long-term consequences can be delayed development and different responses to pain (5). The sensory area of the brain is its most active region, in which the pathways for pain transmission are highly developed, while the inhibitory systems are not appropriately grown (6). Therefore, algology in full-term neonates is of the utmost importance.

Furthermore, pain alleviation can reduce physiological instability, behavioral stress, as well as hormonal and metabolic changes associated with painful procedures (6). Accordingly, the implementation of several methods to relieve pain in full-term neonate is essential. The most obvious and effective approach to pain management in the neonates is to impose limitations on painful procedures and to use pharmacological and non-pharmacological techniques to control pain.

Because of the restricted use of sedatives and analgesics, potential side effects of the commonly used analgesics, non-pharmacological options for easing pain attracted the attention of nursing systems and patients (2, 7). Moreover; such interventions are simple, effective, and low-risk and require a specific time to be implemented using inexpensive equipment. It should be noted that the adverse effects of medications are not observed in these techniques to reduce pain (8).

In this regard, nurses play a major role in providing care; further, they can effectively have the tasks of pain relieving. As a result, they must have enough information about the examination and measurement of pain intensity, as well as complementary and non-pharmacological techniques to decrease pain (9). Sensory stimulation therapy as a non-pharmacological method includes positioning, swaddling, non-nutritive sucking with music therapy and lullabies, and Yakson therapeutic touch.

Another method is using nutritional supplements such as sweet oral solutions. The last one is supportive techniques entailing exposing to mother's scent, breastfeeding, skin-to-skin contact, and kangaroo care (10). The given interventions may directly block the pathways for pain transmission, enable the inhibitors, cause changes in pain modulators, or indirectly reduce pain through moderating painful stimuli (11).

Regarding the evidence, cry can be considered as a strong indicator of pain and an important behavioral response to pain (12). Therefore, numerous instruments were designed to measure neonatal pain intensity. Moreover, there are invasive procedures occur routinely in neonatal units. Capillary blood sampling via the heel lance is the gold standard method for thyroid screening in healthcare centers. In this method, contact and pressure on the heel to take blood samples from full-term infants during this procedure can be a painful stimulus (12).

It is worth mentioning that sensory stimulations are among the basic human needs, especially for growth and development (13). In this respect, massage is a common method to soothe newborns during stressful times and tension caused by pain. According to the context, the use of massage therapy, especially Yakson therapeutic touch has no negative effect on full-term neonates.

Furthermore, if this therapy is performed in a gentle manner, it can create satisfaction and consequently demonstrate its therapeutic impacts (14). However, due to limitations arising from the need for neonatal care and sometimes relative isolation periods, they are deprived of tactile stimulations. Nurses are always refrained from touching newborns because of the fear of psychological distress due to overstimulation. Although it is confirmed that complementary non-pharmacological methods such as massage therapy, physiological responses coming from hormonal changes, and increased levels of endorphins and serotonin trigger off the sense of relaxation, there are few studies regarding therapeutic touch safety (15).

In this study, heel warming was investigated as a method that can be easily used in healthcare centers and neonatal units. When the environmental temperature is higher than the body temperature, skin surface temperature is likely to increase. As a result, putting a hot-water bottle on neonates' heels can increase the skin temperature, dilate blood vessels, and augment peripheral blood flow.

Heel warming is a special method used to reduce pain in neonates (16). Therefore, the purpose of this study was to compare a topical method (heel warming) because of its easy administration in healthcare centers and neonatal units, a general method (Yakson therapeutic touch) in order to soothe full-term newborns, and training mothers to use this massage therapy to effectively make communication with their neonates and soothe them at home.

**Methods**

This randomized clinical trial was conducted among three groups of Yakson therapeutic touch, heel warming, and control with 26 full-term neonates per group in 2017. The 3 to 5 days old subjects were healthy and referred to healthcare centers including Danesh Amooz, Shahrak Lashgar, and Imam Reza Centers in Mashhad, Iran, for thyroid and phenylketonuria screening.

The sample size was calculated using the comparison of means formula based on the study performed by Shu in 2006 on the efficacy of swaddling and heel warming on response to pain from heel stick procedure in neonates (12). In the mentioned study, one of the variables was heel warming similar to that used in the present study. According to the results of Shu's study, the standard deviations of the Neonatal Infant Pain Scale (NIPS) in the control and heel warming groups were 6.4 and 4.3, respectively.

Therefore, the sample size was computed as 25 subjects per group using the Shu's results, effect size of the intervention (0.7), 90% test power, and 0.05 significance level. It should be noted that no sample attrition was observed in this study, and 26 full-term neonates were included in each group. A total of 78 full-term newborns were assigned into the study groups using randomization block and drawing method.

In this respect, the first subject was placed in the first intervention group (Yakson therapeutic touch), the second one was allocated to the second intervention group (heel warming), and the third one was placed in the control group (routine care). Sampling was continued in the same way until the complete allocation of the subjects to the study groups. In addition, the allocation of the study subjects was performed without any bias and according to the described method.

The researcher executed all the procedures and interventions; thus, there was no possibility of blindness. In this study, the inclusion criteria entailed the gestational age of 38 to 42 weeks, birth weight of 2.50 to 3.99 kg, no congenital anomalies, taking no sedatives and analgesics in the past 24 hours, and non-addicted mothers. The exclusion criteria included the parents' withdrawal to participate in the study and failure in heel-stick blood sampling at the first try.

Data were collected using demographic characteristics form and the NIPS. The demographic characteristics form was consisted of gestational age, gender, birth weight, body temperature, and age. The NIPS can be employed to examine pain intensity in neonates before, during, and after painful procedures such as venipuncture, blood vessel detection, vaccination, and heel stick procedure.

The NIPS as an observational and standard tool was used in many studies regarding neonatal pain. The validity of the NIPS was confirmed by 10 nursing professors at the School of Nursing and Midwifery affiliated to Mashhad University of Medical Sciences, Mashhad, Iran and pediatric specialists. Due to the fitness of this instrument to the research methodology, no changes were made in it.

In addition, the reliability of this tool was confirmed via internal consistency (to assess the stability of the content) as well as inter-rater reliability. The NIPS included six items associated with cry (0-2),

facial expressions (0-1), the pattern of breathing (0-1), hand movements (0-1), leg movements (0-1), and the level of consciousness (0-1). The scores from 0 to 2, 3 to 4, 5 to 7 shows mild, moderate, and severe pain, respectively (16).

In this study, the neonates were placed on a bed supine in a quiet environment before, during, and after the intervention. In the first intervention group, the non-dominant hand was placed on the neonates' back and the dominant hand was put on their chest and abdomen. According to the protocol of Yakson touch, the researcher wore a clean gown and washed their hands thoroughly with antimicrobial agents for 3 minutes and then warmed their hands using a warmer up to the temperature of 34°C.

The temperature of the hand was measured using a digital thermometer. At the next step, the researcher relaxed their both arms and shoulder muscles for a minute and took a deep breath to concentrate the vital energy in the palm of their hands. Then, the researcher started Yakson therapeutic touch as explained for 15 minutes. In addition, 5-minute was considered for the palm rest, while one hand was resting on the neonate's chest and abdomen, and the neonate was supported with the other hand.

Additionally, the researcher concentrated the energy in their resting hands with a deep breath to bring a healthy vital energy to the neonate. During this interval, the researcher breathed slowly to keep their calm; thereafter, they had gentle touches for 5 minutes in the same hand position and repeated the rest for 5 minutes, touched the neonate (1 minute), had a rest (30 seconds), touched again (1 minute), rested (30 seconds), and touched for the third time (2 minutes).

Moreover, the researcher touched the neonate's abdomen and chest in a clockwise direction and circular motion with the diameter of 1 cm every 10 seconds with 5 minutes of rest again and repeated their hand rest in the same way as described above. During Yakson therapeutic touch, the palm and all the fingers of the researcher were constantly in close contact with the neonate; thus, the newborn felt no pressure (17).

It has not escaped our notice that the researcher learned Yakson therapeutic touch under the supervision of traditional medicine professors and massage therapists along with watching video clips downloaded from trusted scientific sites. In the second intervention group, water at 40°C was poured into a bottle, and then the bottle was placed for 5 minutes on the opposite direction of the hole on the outside of the neonate's heel. Moreover, heel-stick procedure was performed immediately after the removal of the hot-water bottle (12).

The subjects in the control group were placed in a supine position lying without any interventions before taking blood samples from their heels and then heel-stick blood sampling was conducted. The researcher measured the vital signs of the neonate at the pre- and post-intervention phases using a pulse oximeter, evaluated pain intensity by the NIPS after the procedure, and examined cry duration from the insertion of the lancet to the end of cry with a stopwatch after watching the films produced from neonates.

After obtaining permission from the Deputy of Research of Mashhad University of Medial Sciences, Mashhad, Iran, explaining the objectives, and gaining approval from the Healthcare Centers authorities, sampling was conducted from September 23 to November 11, 2017, on all weekdays from 8 to 12 am. The researcher started the sampling by providing a written letter to the Healthcare Center authorities, coordinating with the staff, and explaining the research project in detail.

Firstly, the eligible full-term infants were identified, and then the interventions in the two study groups were performed using Yakson therapeutic touch and heel warming after explaining the purpose of the study and obtaining consent from the parents. To take blood samples, the researcher assistant disinfected neonate's feet with alcohol and inserted the lancet on the side of the heel.

During the intervention, a written consent was obtained from the parents to film the newborns in order to examine the results of the NIPS. Data analysis was performed using SPSS software, version 16. Initially, using the Kolmogorov-Smirnov test, the normality of the quantitative variables was tested, and then the analysis of variance (ANOVA) was employed to compare the groups in terms of normal quantitative variables. Moreover, Kruskal-Wallis test was used to measure the non-normal quantitative variables and the ranked ones.

Furthermore, the nominal variables including Yakson therapeutic touch and heel warming were compared using Chi-squared test and Fisher's exact test. Kruskal-Wallis test was used to evaluate the dependent variables entailing pain, cry duration, and physiological criteria.

## Results

The mean and the standard deviation of the neonates' ages in the first and second intervention and control groups were 4.7±1.0, 5.1±2.4, and 4.1±0.7 days, respectively (P=0.12). The results of the Chi-squared test indicated no significant difference between the groups in terms of the method of delivery (P=0.27). Further, it was showed that the groups were not significantly different considering gender (P=0.34).

The results of Fisher's exact test demonstrated that the groups were homogenous regarding the parents' employment status (P=0.32). According to the results, the study groups were homogeneous in terms of other variables (Table 1). In addition, post-intervention mean scores of the NIPS in the first and second intervention and control groups were 2.8±1.6, 4.8±1.8, and 4.4±1.7, respectively (P≤0.02). Given the pairwise comparison of the groups, the results of the Bonferroni post-hoc test revealed a significant difference between the first and second intervention groups and between the first intervention and control groups (P≤0.002 and P≤0.01; Table 2).

According to the results of Kruskal-Wallis test, the study groups had no significant difference in the mean and the standard deviation of respiratory rate at the pre-intervention stage (P=0.32). The mean respiratory rate at the post-intervention phase in the first and second intervention and control groups were 49.8±4.0, 57.0±4.08, and 53.4±5.04, respectively (P<0.01). Moreover, the results of Wilcoxon signed-rank test demonstrated that the post-intervention respiratory rate did not significantly increased (P=0.23).

The findings of paired t-test suggested that respiratory rate in the second intervention group after the procedure had a significant difference compared to before sampling (P=0.004). Furthermore, the results of intra-group Wilcoxon signed-rank test in the control group showed a significant difference in respiratory rate after the procedure compared to the stage before sampling (P=0.007; Table 3).

Finally, the analysis and the conclusions were based on comparing the difference between respiratory rate before and after heel-stick blood sampling. In this respect, there was no significant difference between the study groups (P<0.72). As well, the results of Kruskal-Wallis test indicated no significant difference between the study groups in terms of the mean heart rate before heel-stick procedure (P=0.08).

**Table 1. Comparison of demographic characteristics parameters in intervention and control groups**

| Variables | | Yakson therapeutic touch group (%) | Heel warming group (%) | Control group (%) | Test results |
|---|---|---|---|---|---|
| Maternal educational status | Illiterate | 0 (0.0%) | 1 (3.8%) | 0 (0.0%) | *P=0.02 |
| | Primary school | 3 (11.5%) | 2 (7.7%) | 0 (0.0%) | |
| | Junior high school | 5 (19.2%) | 4 (15.4%) | 2 (7.7%) | |
| | High school diploma | 3 (11.5%) | 8 (30.8%) | 16 (16.5%) | |
| | Higher education | 15 (57.7%) | 11 (42.3%) | 8 (30.8%) | |
| Method of delivery | Natural vaginal delivery | 14 (53.8%) | 12 (46.2%) | 11 (42.3%) | **P=0.007 |
| | Cesarean section | 12 (46.2%) | 14 (53.8%) | 15 (57.7%) | |
| High-risk pregnancy | Yes | 6 (23.1%) | 0 (0.0%) | 0 (0.0%) | ***P=0.002 |
| | No | 20 (76.9%) | 26 (100%) | 26 (100%) | |
| Gender | Female | 12 (46.2%) | 11 (42.3%) | 16 (16.5%) | **P=0.34 |
| | Male | 14 (53.8%) | 15 (57.7%) | 10 (38.5%) | |
| Employment status of mothers | Housewife | 22 (84.6%) | 25 (96.2%) | 22 (84.6%) | ***P=0.32 |
| | Employed | 4 (15.4%) | 1 (3.8%) | 4 (15.4%) | |

*Kruskal-Wallis test **Chi-squared test ***Fisher's exact test

**Table 2. The mean and standard deviation of pain intensity after heel stick blood sampling in the included full-term neonates**

| Pain | Yakson therapeutic touch group | Heel warming group | Control group | Inter-group Kruskal-Wallis test results |
|---|---|---|---|---|
| | Mean±standard deviation | Mean±standard deviation | Mean±standard deviation | |
| After heel stick blood sampling | 2.8±1.6 | 4.8±1.8 | 4.4±1.7 | P=0.02 |

**Table 3. Mean and standard deviation of respiratory rate before and after heel stick blood sampling in the included neonates**

| Respiratory rate per minute | Yakson therapeutic touch group | Heel warming group | Control group | Inter-group test results |
|---|---|---|---|---|
| | mean±standard deviation | mean±standard deviation | mean±standard deviation | |
| Before blood sampling | 47.4±3.2 | 52.2±4.2 | 50.8±3.8 | *p=0.32 |
| After blood sampling | 49.8±4.0 | 57.0±4.8 | 53.4±5.4 | **P=0.01 |
| Difference between pre-and post-sampling stages | 2.4±3.8 | 4.87±3.0 | 2.6±3.0 | *P=0.72 |
| intra-group test results | ***P=0.23 | ****P=0.004 | ***P=0.007 | |

*Kruskal-Wallis test **Analysis of variance, *** Wilcoxon signed-rank test, **** Paired t-test

**Table 4. Mean and standard deviation of heart rate before and after heel stick blood sampling in the included neonates**

| Heart rate per minute | Yakson therapeutic touch group | Heel warming group | Control group | Inter-group test results |
|---|---|---|---|---|
| | Mean±standard deviation | Mean±standard deviation | Mean±standard deviation | |
| Before blood sampling | 96.3±4.8 | 97.9±11.9 | 97.7±6.8 | P=0.08 |
| After blood sampling | 98.4±5.7 | 103.0±14.0 | 105.4±7.3 | P=0.03 |
| Difference between pre- and post-sampling stages | 2.1±4.3 | 5.1±6.4 | 7.7±4.2 | P=0.06 |
| Intra-group test results | P=0.0.14 | *P=0.008 | **P=0.007 | |

*Paired t-test **Wilcoxon signed-rank test

The mean heart rate after taking blood samples in the first and second intervention and control groups were 98.4±5.7, 103.0±14.0, 10.54±7.03, respectively (P<0.03). The pairwise comparison of the groups using the Bonferroni post-hoc test indicated a significant difference between the first and second intervention groups and first intervention and control groups (P≤0.03, P≤0.01, respectively). The results of paired t-test revealed no significant increase in heart rate in the first and secon intervention groups after the procedure (P=0.14). However, there was a significant difference between the second intervention and control groups regarding the increased heart rate after sampling (P≤0.008, P≤0.001, respectively; Table 4). Considering the results, no significant differenc was observed between the study groups regarding the heart rate before and after blood sampling (P=0.06).

The mean cry durations after taking blood samples in the first and second intervention and control groups were 10.1±16.3, 41.3±46.7, and 29.3±30.5 seconds, respectively. Therefore, the cry duration in full-term neonates included in thesecond intervention group was almost 300% more than those in the first intervention group (P≤0.03). In this regard, the pairwise comparison of the groups demonstrated a significant difference between the first and second intervention groups (P≤0.04, P≤0.02, respectively).

## Discussion

In this study, the effects of Yakson therapeutic touch and heel warming on pain from heel-stick blood sampling, vital signs, and cry duration in full-term neonates were investigated. Considering the results of this study, Yakson theraputic touch significantly affected pain, stability of vital signs, and cry duration in the subjects. Concerning the determination and the comparison of pain intensity in the study groups, the results showed that the mean pain intensity after blood sampling was significantly lower in the first intervention group than that in other two study groups.

The mean pain intensity in the second intervention group was higher than that in the first intervention group, but lower than that of the control group. In the study investigating the effect of Yakson therapeutic touch and non-nutritive sucking on pain during heel-stick blood sampling, Im et al. in 2007 found that massage therapy could improve arterial oxygenation, affect the nocireceptors in the skin and pain pathways in the brain, and consequently bring about pain relief.

The results of the present study indicated that heel warming had no significant impact on pain in newborns; however, it could cause vasodilation and improved blood flow in full-term neonates (18). According to the results of the study conducted by Shu et al. in 2006 on the efficacy of swaddling and heel warming on pain response to heel stick in neonates aged between 31 and 42 weeks, the mean score of pain intensity was lower in the swaddling group compared to the heel warming group. It was concluded that heel warming led to better blood flow due to vasodilation (12).

Further, cry is known as a common behavioral indicator and one of the ways to express pain in full-term newborns in different forms. Cry of pain is sharp and it seems like screaming depending on the reason, which needs urgent care by caregivers. In addition, the severity of cry varies according to pain intensity (17). Accordingly, cry duration index is used as a pain measurement tool in researches and its validity is confirmed by several studies (18).

For example, the results of the study performed by Forth et al. using cry as a variable in addition to the NIPS showed that the rhythm, severity, and duration of cry in infants in response to stimuli could vary in a diagnosable manner. Accordingly, it could be used as a pain assessment and measurement instrument. It is worth mentioning that Yakson therapeutic touch used in the present study could cause heel pain relief during heel stick blood sampling; however, no significant changes were observed in pain intensity scores in the group with heel warming. It might be due to the stimulation of nocireceptors by heat.

In this study, cry duration in the first intervention group was significantly lower than that in the other groups. Additionally, cry duration in full-term neonates in the second intervention group was longer than that in the other groups, which could be due to the stimulation of nocireceptors by topical heat. Placing hot-water bottles with the temperature of 40-45°C could stimulate nocireceptors, increase the secretion of substances causing pain in the heel, and then increase the cry duration (16).

The findings of this study demonstrated that the topical use of heat could cause increased scores of the NIPS as well as cry duration in newborns. In the present study, the full-term newborns in the second intervention group cried more than those in the other groups. It should be noted that the given group had much longer cry duration compared to the control group, which received no interventions.

However, no significant changes were observed in heart and respiratory rates in the second intervention group. In this study, the mild intensity of pain caused by the lancet for taking blood samples from the heel or physical and psychological conditions prevailing in the study led to no significant changes. Nevertheless, it has not escaped our mind that changes in heart and respiratory rate were lower in the group receiving Yakson therapeutic touch.

According to the study conducted by Jain in 2006, who investigated the effect of leg massage on the response to pain in heel-stick blood sampling in neonates aged less than 37 weeks old, the respiratory rate before and after the massage therapy and after taking blood samples from showed no significant difference. In this respect, only a slight increase was observed in the respiratory rate in infants in the control group. The findings of the study by Jain indicated that heart rate and the NIPS scores in the control group increased (19).

There were several limitations in this study. Firstly, the past pain experiences of the neonates could not be recorded, especially among those with a history of several heel-stick blood samplings. Secondly, the skills of taking blood samples from the heel in all nurses were not the same and the pain threshold in all full-term neonates were not equivalent. Finally, this study was conducted among full-term newborns aged between 38 and 42 weeks old, and it could not be generalized to all newborns including preterm neonates.

Nonetheless, placing the study subjects in a randomized manner in three groups, as well as performing the blood sampling for all the participants by one person were the strategies adopted to moderate the impacts of these limitations as much as possible.

**Implications for Practice**

The results of the present study revealed that Yakson therapeutic touch could cause significant differences in cry duration among full-term neonates in the intervention group. Therefore, it was recommended to use this method to alleviate pain caused by heel stick blood sampling only if the physical conditions necessary for this type of massage and the room with the temperature of 26°C for the application of this method are provided. Certainly, further studies are needed to find an approach consistent with the existing conditions.

Teaching Yakson therapeutic touch to mothers referred to healthcare centers can help them soothe their neonates, improve their sleep, and ultimately enhance their nutrition and weight gain. Moreover, skin-to-skin contact between mother and infant can affect neonate's neurodevelopment and consequently strengthen emotional bonds between them. Therefore, teaching massage therapy and practicing it can aid parents to increase their attachment to babies and ensure them in terms of parenting skills.

In the upcoming studies, comparative investigations can be conducted on the effect of Yakson therapeutic touch and heel warming on initial pain induced by vitamin K injections in term infants or the impact of Yakson therapeutic touch and heel warming on pain caused by heel stick blood sampling, vital signs, and cry duration in preterm newborns.

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**Conflicts of Interest**

The authors declare that there is no conflict of interest regarding the publication of this article.

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