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ORIGINAL ARTICLE

# The Effect of Skin-To-Skin Contact during Heel Lance on the Physiological Parameters, Pain and Stress Level of the Term Newborn and Maternal Anxiety Level

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## Abstract

**Objective:** The study was conducted at Sakarya University Hospital Obstetrics Clinic, in Sakarya Province, in Turkey, from January 2019 to February 2019, as a simple randomized (1: 1), experimental, and prospective study. It was aimed to evaluate effect of skin-to-skin contact (SSC) on physiological parameters, pain-stress level of newborn and anxiety level of mother during this stage.

**Method:** In the study, 34 of 68 healthy term newborns were included control group, 34 of them were intervention group. Control group, no other intervention was done except routine applications to evaluate anxiety level of mothers. Intervention group, SSC with mother was ensured while drawing blood from heel and pain-stress level of newborn and its effect on level of anxiety of mother were studied.

**Results:** When the results of ALPS-NEO Pain Scale were compared between groups, It was found that effect of SSC during heel lance on pain-stress level of newborns in intervention group was significantly lower than control group.

**Conclusion:** As a result, SSC application can be used as a supportive method during heel lance, which is a painful procedure. However, there was no statistically significant result on anxiety of mothers.

**Keywords:** Heel blood, Newborn, Nurse, Procedural pain, Skin-to-skin contact

## Introduction

There are many procedures applied to newborn for diagnosis and treatment, which cause pain and stress (Ceylan & Bolışık, 2017a; İçke & Ekti Genç, 2017). One of procedures applied according to procedures is the Guthrie Screening (Arıkan et al., 2017). The screening test was developed in the early 1960s and included in evaluation of newborns for phenylketonuria (PKU) (Altunhan & Yılmaz, 2018; Arıkan et al., 2017). The procedure of heel lance from the newborns, where the nerve conduction is intense, increases pain and stress level in newborn (Johnston et al., 2017). Pain is defined as an "unpleasant, sensory and emotional experience described as associated with, or not related to, actual or potential tissue damage" by the Taxonomy Committee of the International Association for the Study of Pain (IASP) (1979) (Çakşak, 2017; Yağcı & Saygın, 2019). Pain management is a very important phenomenon, especially for newborn, since newborn cannot express pain verbally (Evcili et al., 2017; Özçevik & Ocakçı, 2019; Uğurlu et al., 2014;). Researches indicated that perception of pain felt in this period has many effects on the formation of pain response in later life (Couture, 2016; Yeum et al., 2004). According to the American Nurses Association (ANA), the management of pain and pain relief is an ethical imperative for nursing practice (American Nurses Association, 2001). Pain assessment should be an important nursing responsibility and the basis of pain management. It is one of the duties of nurse to be able to diagnose pain of newborn and to prevent pain while intervention is being planned and applied (Ceylan & Bolışık, 2017b). Nurse should also take a role in bonding of newborn and mother and should guide mother about feeling competent in care and feeding of newborn (Cleveland et al., 2017). Painful interventions applied to newborns can also be an anxious process for parents. In addition to neurological and emotional development of newborn, pain can negatively affect behavior of newborn, newborn–parent communication, and bonding

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process (Evcili et al., 2017). SSC is a method that improves relationship between parent-newborn and has benefits for parent and newborn (Arpacı & Altay, 2017). In this context, it positively affects adaptation of newborn in transition from intrauterine life to extrauterine life by making baby feel safe (Çakşak, 2017). It was also found out that mothers who actively used SSC had higher bonding scores measured in postpartum bonding questionnaire and were less concerned about newborn care (Pineda, 2014). Despite this, the number of studies, which measure stress and anxiety levels of parents with newborns who are exposed to painful stimuli caused by mandatory procedures is limited (Evcili et al., 2017).

As a result of literature review, it was seen that although studies about the effects of SSC on preterm newborns were conducted, there was a limited number of study which evaluated pain and stress levels of term newborns during SSC application while heel lance was being performed. This research was conducted in a clinical setting as a simple randomized (1:1) controlled, experimental, prospective study for purpose of evaluating the effect of SSC on the physiological functions and pain and stress of newborn while performing heel lance and determining effects on mother's anxiety level.

In this study, we tested the hypothesis that a policy of active management of nulliparous labor would be in the following;

1. The effect of SSC on pain and stress level of newborn.
2. The effect of SSC on physiological parameters of newborn.
3. The effect of the procedural pain sequence applied to newborn on mother's anxiety level.

## Material and Methods

Study groups were consisted of term newborns who are with their mothers and in a good condition without any operation history. Newborns taken to the NICU (Neonatal Intensive Care Unit) for various reasons were excluded from the study. The invasive procedure applied to all newborns in the research was heel lance. No pain reliever or sedative medication was given, and no painful intervention was performed in the last hour. Newborn was fed within last half an hour before the heel lance. In the study, newborns were delivered through vaginal birth, the gestational age was 38–42 weeks, the 5$^{th}$ minute APGAR score was 7 and above, they were clinically healthy, their general condition was stable, there was no congenital anomaly, no feeding problem, the birth weight was 2500 g or more, fed normally 30 minutes earlier. Written permit of parent was obtained for including baby in study, and study was designed as simple randomized (1:1) one with as newborn control and intervention groups. The dependent variables of the research were newborn pain and stress level and maternal anxiety level; the independent variables were SSC and heel lance. At the confidence level, a total of 68 term newborns were identified, 34 for each group, according to sample volume calculations. The steps followed during the calculation of the sample volume were the calculations made by taking the 1$^{st}$ type error margin ($\alpha$) = 0.05, effect size = 0.8, and test power = 0.90. The selection of newborns to groups was done by simple randomization by drawing lots by healthcare personnel other than researcher. Research was conducted at Sakarya University Training and Research Hospital Obstetrics Clinic from January 2019 to February 2019. Ethics committee approval dated 03.01.2019 and numbered E.97 from Sakarya University Medical Faculty Non-Invasive Ethics Committee and official institution permission from Sakarya University Training and Research Hospital was obtained for the application of the study. The capacity of the test to determine the significant difference between the groups is revealed by the test power (1-$\beta$). The data was collected using Newborn Information Form, Descriptive Information Form of the Mother, ALPS-NEO Pain and Stress Rating Scale, Intervention Follow-up Form, State-Anxiety Scale, Trait-Anxiety Scale. Before the procedure, physiological parameters of newborn were evaluated. Heart apex beat, saturation value, respiratory rate and crying times were observed and recorded. Except for routine clinical applications for 15 minutes, no application was applied to control group and newborns were observed. In intervention group, newborn and mother remained in SSC for at least 15 minutes. Application of SSC was such that newborn was laid on mother's chest with only diaper and a cap on. It was ensured that SSC was actively applied for 30 minutes during the total planned operations. For normality tests, Kolmogorov-Smirnow and Shapiro–Wilk techniques were used. As a result of analysis, it was concluded that if the "*p*" values were greater than 0.05, the data were normally distributed, and if $p < .05$, the data were not normally distributed. While average comparison tests were performed, the mean values were compared using the Independent Samples *T*-Test if the data is normally distributed, and the Mann–Whitney *U*-test and the Chi-Square test were used if the data is not normally distributed. In the evaluations done before and after the procedure, *t* test (Paired Samples *T*-Test) and Wilcoxen sign test were used in dependent groups. The data obtained in this study were analyzed using SPSS 21 package program (IBM SPSS Corp.; Armonk, NY, USA). Written consent was obtained from parents of newborns before the study, explaining the purpose, duration, and procedures to be applied to newborn.

**Main Points**

- Procedural pain management is a very important phenomenon, especially from the point of view of the newborn, as it cannot express its pain verbally. Pain assessment should be an important nursing responsibility and the basis of pain management.
- Skin-to-skin contact (SSC) is a step in mother-newborn bonding that makes the baby feel safe and positively affects the adaptation from intrauterine life to extrauterine life.
- During the painful medical and nursing procedures, SSC can be used as non-pharmacological pain management for newborns in order to ensure environmental and behavioral interaction, which are important elements of developmental care.
- SSC can be added for the Obstetrics Clinic to be applied in the hospital or clinical routine interventions in the NICU. Neonatal care can be supported together with the mother.

## Results

### Data on Properties of Newborn and Mothers

When newborns were compared in terms of week of gestation, postnatal life day and APGAR score at 5th minute, no statistically significant difference was found between groups ($p > .05$). In terms of readiness to be a mother when mother learnt that she was pregnant, it was found that 23 (67.6%) mothers from intervention group felt ready, and 24 (70.6%) mothers from control group felt ready.

### Data on Neonatal Pain and Stress Level

ALPS-NEO values were identified to be significantly higher in control group compared to intervention group ($p < .05$, Table 1). When average crying duration before the procedure was compared by groups, it was 0.7 ± 1.4 seconds in intervention group and 2.4 ± 2.2 seconds in control group. During the procedure (1st minute), average crying control in intervention group was 6.1 ± 4.2 seconds, and 15.1 ± 6.0 seconds in control group. After the procedure (5th minute), average crying duration was 0.9 ± 1.7 seconds in intervention group and 2.2 ± 2.3 seconds in control group. According to average crying duration, newborns in control group had significantly higher crying duration than in intervention group. ($p < .05$).

### Data on Physiological Parameter of Newborn

In control group, heart apex beat data before, during the procedure (1st minute) and after the procedure (5th minute) were found to be significantly higher than the intervention group. ($p < .05$, Table 2). Respiratory rates of the groups before the procedure, during the procedure (1st minute) and after the procedure (5th minute) was found to be significantly higher in control group compared to intervention group ($p < .05$, Table 3).

### Data on Saturation Values by Groups

Depending on found data, we can say that when saturation values of groups were compared before and after the procedure (5th minute), no significant difference was found

**Table 1**
***Data on ALPS-NEO Scale and Crying Duration by Groups***

| | | Group | | | | | | Mann–Whitney U | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | Mean | Median value | Minimum | Maximum | SD | Line ave. | z | *P* |
| | Intervention | 34 | 2.8 | 2.0 | 0 | 8.0 | 2.0 | 21.5 | | |
| ALPS-NEO | Control | 34 | 6.7 | 7.0 | 0 | 9.0 | 2.4 | 47.5 | −5.4 | 0.0001 |
| | Total | 68 | 4.8 | 4.5 | 0 | 9.0 | 2.9 | | | |

**Table 2**
***Heart Rate Data by Groups***

| | | Group | | | | | | Mann–Whitney U | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Peak heart rate (min) | | *n* | Mean | Median value | Minimum | Maximum | *SD* | Line ave. | *z* | *p* |
| | Intervention | 34 | 124.4 | 124.5 | 104.0 | 150.0 | 11.9 | 27.8 | | |
| Before the procedure | Control | 34 | 132.0 | 132.0 | 108.0 | 156.0 | 11.2 | 41.2 | −2.78 | .005 |
| | Total | 68 | 128.2 | 128.5 | 104.0 | 156.0 | 12.1 | | | |
| | Intervention | 34 | 143.9 | 145.0 | 107.0 | 174.0 | 15.4 | 22.4 | | |
| During the procedure (1st minute) | Control | 34 | 164.9 | 168.5 | 130.0 | 180.0 | 11.4 | 46.6 | −5.06 | .0001 |
| | Total | 68 | 154.4 | 158.5 | 107.0 | 180.0 | 17.1 | | | |
| | Intervention | 34 | 123.1 | 120.0 | 108.0 | 148.0 | 11.8 | 27.2 | | |
| After the procedure (5th minute) | Control | 34 | 132.3 | 130.0 | 108.0 | 160.0 | 10.4 | 41.8 | −3.06 | .002 |
| | Total | 68 | 127.7 | 130.0 | 108.0 | 160.0 | 11.9 | | | |

**Table 3**
***Respiratory Rate Values according to Groups***

| Respiratory rate (min.) | | Group | | | | | | Mann–Whitney U | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | Mean | Median value | Minimum | Maximum | *SD* | Line ave. | *z* | *p* |
| Before the procedure | Intervention | 34 | 42.9 | 42.0 | 40.0 | 50.0 | 3.7 | 28.3 | | |
| | Control | 34 | 45.4 | 46.0 | 40.0 | 56.0 | 3.6 | 40.7 | −2.66 | .008 |
| | Total | 68 | 44.1 | 42.0 | 40.0 | 56.0 | 3.9 | | | |
| During the procedure (1st minute) | Intervention | 34 | 50.3 | 50.0 | 40.0 | 66.0 | 7.1 | 22.0 | | |
| | Control | 34 | 61.9 | 62.0 | 44.0 | 76.0 | 6.5 | 47.0 | −5.24 | .0001 |
| | Total | 68 | 56.1 | 58.0 | 40.0 | 76.0 | 8.9 | | | |
| After the procedure (5th minute) | Intervention | 34 | 43.0 | 42.0 | 40.0 | 50.0 | 3.2 | 29.3 | | |
| | Control | 34 | 45.6 | 46.0 | 40.0 | 56.0 | 4.8 | 39.7 | −2.21 | .027 |
| | Total | 68 | 44.3 | 43.0 | 40.0 | 56.0 | 4.2 | | | |

($p > .05$). However, it was found that saturation values of newborns in intervention group were statistically significantly higher than control group during the procedure ($p < .05$).

**Maternal Anxiety Level Data**

When the mean occasional anxiety values of mothers were compared during the process of heel lance of newborns, it was found to be 54.21 ± 6.65 points for mothers in intervention group, and 52.59 ± 6.47 points for the mothers in control group. The mean constant anxiety value was determined to be 14.50 ± 8.15 points in intervention group and 15.21 ± 5.17 points in control group. There was no statistically significant difference between groups in terms of mean occasiona/ constant anxiety scores ($p > .05$).

**Discussion**

As a result of the discussion of the effect of heel lance application on pain and stress level of newborn by groups, Gray et al. (2000), who argued that SSC was effective in management of procedural pain, found that SSC reduced crying by 82% and grimacing by 65% compared to control group (Gray et al., 2000). They also stated that the differences in crying durations spread to post-procedure process. Newborns in intervention group whose mothers underwent SSC cried for 1 second on average and grimaced for 2 seconds during the recovery period. However, newborns in control group cried for 32 seconds on average after procedure and grimaced for 30 seconds. According to the data of the study conducted by Ludington-Hoe who investigated the effect of SSC application on neonatal procedural pain, intervention group emphasized that heart apex beat, respiratory rate and oxygen saturation of newborn were within normal limits, it regulated sleep and reduced pain (Ludington-Hoe, 2011). According to the research results of Saeidi et al. (2011) who applied SSC during heel lance, pain score of 93.3% of newborns in intervention group was 0 points and 70% of newborns in control group was 0 points after procedure(Saeidi et al., 2011). Kostandy et al. (2013) who investigated the effect of SSC on newborn pain, which is a non-pharmacological method, found that crying of newborn increased as squeezing process continued during the procedure, and the pain score increased simultaneously(Kostandy et al., 2013). Mosayebi et al. (2014) conducted a study on newborns where 62.5% of intervention group newborns who underwent SSC during the heel lance procedure experienced mild pain (score: 0–6), while 26.2% of control group newborns got similar scores (Mosayebi et al., 2014). According to the findings of Seo et al. (2016), who investigated the effects of SSC on relieving pain while heel lancing on newborn, argued that there was a complex relationship between pain and other defense systems, and suggested that only one aspect of the response to painful stimuli made it difficult to produce a single result. In addition, the average crying time in intervention group where SSC was applied was 17.76 ± 38.92 seconds and average crying time in control group was 149.26 ± 92.88 seconds ($p < .001$), and it was statistically confirmed that intervention group cried for a shorter period than control group (Seo et al., 2016). In the Johnston et al. (2017) study, systematic review, newborns were compared according to their crying time, and among them, those in intervention group stated that they cried for an average of 65 seconds, and those in control group for an average of 184 seconds. Heart apex beat, oxygen saturation changes and crying duration were found to be significantly lower in

intervention groups compared to control group (Johnston et al., 2017). In the studies conducted by Ataman (2019), Baharlooei et al. (2017), Disher et al. (2017), and Küçükoğlu (2017) , it was found that intervention group newborns who underwent SSC during the procedure had lower pain scores which were statistically significant. SSC provides the stability of newborn by reducing pain and stress of the newborn. SSC can be used to relieve newborn pain during procedural interventions such as heel lance.

In terms of the effect of SSC on physiological parameter values of newborns by groups; during the heel lance, the SSC intervention group prevented a significant increase in heart apex beat according to Gray et al. (2000). This stability was maintained after the procedure, which is the recovery period. According to the data recorded, the heart apex beat of control group increased to the level of 160 bpm and approximately 36–38 heartbeat increased per minute. Investigating the effect of SSC during the administration of hepatitis B vaccine in 2013, Kostandy et al. (2013) found that newborns in intervention group cried significantly less than newborns in control group, and reached the the behavioral stability in a shorter time, and tended to a decrease in heart apex beat in a shorter time. In another study conducted by Kostandy and Ludington-Hoe (2016) again, the effect of SSC application on clustered pain was investigated and found out that oxygen saturation, crying time and behavioral status showed rapid improvement after the procedure and returned to the baseline in intervention group undergoing SSC. Oxygen saturation decreased to 92% during the 30 seconds of heel squeezing period, but it increased back to 97% within 30 seconds (Kostandy & Ludington-Hoe, 2016). One of study showed that recorded higher cardio-respiratory system stability scores in intervention group (Moore et al., 2016). According to the comparison of the data of intervention group and control group newborns in the study where the effect of SSC on newborn pain was investigated by Seo et al. (2016), there was no significant difference was found for $Spo^2$ before, during or after the heel lance procedure. After the procedure, the mean heart apex beat of the SSC group was 139.76 ± 10.83 bpm, while it was 151.16 ± 21.89 bpm in control group and was significantly lower . In a systematic review performed by Johnston et al. (2017) including 25 experimental studies investigating the effect of SSC on painful procedures, heartbeat variability results were reported only in two studies and stated that there was no significant difference. According to Küçükoğlu's (2017) findings, when comparing physiological parameters between groups, there was a significant difference in respiratory and oxygen saturation values before and after the procedure. She argued that oxygen saturation before and after the heel lance procedure was not affected by SSC application and was not statistically significant (Küçükoğlu, 2017).

Comparing the maternal anxiety level about heel lance procedure on newborns by the groups, Castral et al. (2015) found high salivary cortisol levels of mothers before heel lance procedure which was weakly associated with high salivary cortisol values in newborns in response to heel lance procedure. They reported that there was no change in salivary cortisol values of mother and newborn groups during the procedure (Castral et al., 2015). It was stated that the harmony between mother and newborn salivary cortisol values supported the maternal stress regulator role of SSC (Castral et al., 2015). Moreover, in their research Moore et al. (2016) argued that SSC was a powerful vagal stimulant that releases maternal oxytocin through sensory stimuli such as touch, temperature and smell, and other influencing factors. They saw that vagal afferents were part of the neuroendocrine system with the significant effect of oxytocin and direct SSC stimulation (Moore et al., 2016). SSC was also stated to reduce maternal stress level (Moore et al., 2016). The longer SSC duration resulted in low cortisol valuesi It was observed that in neonatal period, due to stimuli such as SSC, breastfeeding and vocalization, oxytocin reduces the stress level as it played a role in connecting systems to dopamine pathways (Kostandy & Ludington-Hoe, 2016; Moore et al., 2016).

**Strengths and Limitations**

The research data cannot be generalized to all newborns with the findings of 68 term newborns admitted to the Obstetrics Clinic of Sakarya University Training and Research Hospital. Strengths of the study are ensuring randomization between the intervention and the control groups, performing the randomization by other hospital personnel other than the researchers, controlling environmental factors in the same way for each newborn, applying the heel lance attempt to the newborn by healthcare professionals with at least 10 years of experience, obtaining the findings with the same calibrated measurement devices. The assignment to the groups and selection of the newborns was performed by the clinical nurse by the simple randomization (1:1) lottery method. Written consent of the families was obtained for the study by the researcher and the data were entered into the data collection tools.

In line with the results obtained from the study, it was observed that SSC had significant positive effects in balancing the physiological parameters of the newborn, strengthening the parental neonatal attachment and reducing the psychological stress of the mother in order to provide quality care. During the painful medical and nursing procedures, SSC can be used as non-pharmacological pain management for newborns in order to ensure environmental and behavioral interaction, which are important elements of developmental care. SSC can be added for the Obstetrics Clinic to be applied in the hospital or clinical routine interventions in the NICU. Neonatal care can be supported together with the mother. Parents should be informed about SSC before birth and SSC applications can be expanded. Similar studies are needed in different regions and hospitals to increase evidence-based information. It is recommended that nurses providing primary care both after delivery and in hospitalization of newborns increase their knowledge and follow up-to-date quality care approaches. The reasons for the unwillingness of nurses about SSC application should be determined with new researches to be conducted and

new updated information should be created in order to eliminate the obstacles. Although SSC results are positive in the short term, long term results should also be examined. Further studies can be developed on the effects of SSC on the newborn during clustered painful procedures. Studies should be supported to determine the effectiveness of SSC applied together with other methods with non-pharmacological effects. The presence of any difference between the caregiver role of the mother and the needs of the psychological support mechanism can be determined with future SSC studies addressing mothers with altered mood after birth.

**Ethics Committee Approval:** Ethics committee approval dated 03.01.2019 and numbered E.97 from Sakarya University Medical Faculty Non-Invasive Ethics Committee and official institution permission from Sakarya University Training and Research Hospital was obtained for the application of the study.

**Informed Consent:** Written informed consent was obtained from the parents of newborns before the study, explaining the purpose, duration and procedures to be applied to newborn.

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