Effects of Gentle Human Touch on Preterm Infants: Pilot Study Results

Lynda Harrison, RN, PhD
Linda Olivet, RN, DSN
Kathy Cunningham, RN, BSN
Mary Beth Bodin, RNC, MSN, NNP
Cindy Hicks, RN, BSN

ABSTRACT

A pilot study was conducted to evaluate the effects of gentle human touch (GHT) provided for 15 minutes a day to preterm infants from day 7 to day 12 of life.

The study suggested that GHT has no adverse effects on the oxygen saturation or heart rate levels of small preterm infants and that GHT has a soothing effect as evidenced by decreased levels of active sleep, motor activity, and behavioral distress. These results can provide NICU nurses with a basis for guiding parents in their early interactions with preterm infants in the NICU.

OPPORTUNITIES FOR TACTILE CONTACT WITH THEIR preterm infants help parents cope with their feelings of loss and help them begin to develop feelings of closeness toward their infants.[1] NICU nurses often discourage parents from touching their preterm infants, however, because of the compromised health status of these infants and concerns about hypoxia, increased intracranial pressure, and intraventricular hemorrhage that may result from excessive handling.[2–4] Nurses often make decisions about whether to allow or encourage parental touch based on "educated guesses" or their own experience, rather than on the basis of empirical research.[5]

Previous studies have demonstrated that hypoxia is often associated with handling during medical and nursing procedures.[2,6] Stroking has been found to decrease transcutaneous oxygen pressure ($TcPO_2$) levels in preterm infants from 26 to 30 weeks gestational age.[7] Researchers have suggested the need for further studies to determine whether there are types of touch (other than stroking) that may be enriching or soothing to preterm infants in the NICU.[7,8]

The long-term objective of this project was to identify a type of touch that parents and nurses might provide to preterm infants during the first three weeks of life, when many of these infants are physiologically unstable. The purpose of this study was to evaluate the effects of gentle human touch (GHT) provided for 15 minutes a day to preterm infants (who were from 26 to 32 weeks gestational age) from day 7 to day 12 of life.

LITERATURE REVIEW

The results of several studies suggest that providing supplemental stroking to physiologically stable infants has beneficial effects, including enhanced weight gain and development.[9–11] However, the results of other studies suggest that stroking preterm infants who are not physiologically stable results in signs of behavioral distress (e.g., gasping, grunting, gaze aversion) and decreased $TcPO_2$ levels.[7,12]

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Four small studies have been reported describing preterm infants' responses to "gentle touch." Jay studied the effects of providing "gentle human touch" to a group of 13 mechanically ventilated preterm infants who had a mean gestational age of 29.5 weeks. The intervention consisted of the nurse placing her hands on the infant's head and abdomen for 12 minutes, four times a day, beginning when the infant was less than 96 hours old. Compared with a matched control group of 13 infants, experimental infants had higher hematocrits and required less oxygen.[13]

Tribotti assessed the responses of four physiologically stable preterm infants (32–35 weeks postconceptional age) to gentle touch provided for 15 minutes three times a day over a three-day period. The touch intervention consisted of the researcher placing one hand on the top of the baby's head and the other on the baby's back. During the first session, the experimental group showed decreased $TcPO_2$ levels, increased respiratory regularity, and a slight decrease in motor activity. By the third session, there were increases in $TcPO_2$ and respiratory regularity and a continued decrease in motor activity. These findings suggest that the infants may have learned that the gentle touch was soothing and safe and different from the other types of touch to which they had been exposed previously.[14]

Harrison and colleagues conducted a small pilot study to evaluate the effects of providing 15-minute periods of gentle human touch to three preterm infants three times daily from day 7 to day 17 of life. The infants were in a side-lying or prone position, and the touch involved placing one hand across the infant's head and the other hand across the infant's arm. The infants were 27–32 weeks gestational age at birth. Compared with three infants in a randomly assigned control group, the GHT infants demonstrated greater decreases in serum cortisol levels, fewer days on supplemental oxygen and phototherapy, greater weight gain, and decreased length of hospitalization. There were no significant changes in heart rate or oxygen saturation levels during the GHT periods, and motor activity levels tended to decrease during GHT.[15]

Modrcin-McCarthy evaluated the effects of a GHT intervention that was provided once a day for 20 minutes for 10 days to a group of ten preterm infants (gestational age 28–32 weeks). The GHT sessions began when the infants were 7 days old, and the type of touch provided was similar to that provided by Harrison and colleagues in the previously cited study. There were no differences in oxygen saturation or heart rate levels comparing baseline, touch, and post-touch periods, but there were higher levels of quiet sleep and lower levels of motor activity during GHT periods than during baseline periods. There were no differences between infants in the GHT group and ten infants in a randomly assigned control group in weight gain, number of blood transfusions, or the number of days infants received supplemental oxygen or phototherapy. Infants in the GHT group did show a greater decrease in the percentage of active sleep measured during 45 minutes when they were 17 days old, compared with when they were 10 days old.[16]

TABLE 1 ■ Selected Characteristics of Experimental and Control Group Infants

Variable	Mean (Standard Deviation)* Experimental Group	Control Group
Gestational age (weeks)	30.07 (1.7)	30.6 (1.7)
Birth weight (grams)	1391.8 (295.5)	1333 (265.6)
Apgar at 1 minute	5.67 (2.4)	6.13 (1.8)
Apgar at 5 minutes	7.7 (1.8)	8.07 (1.2)

*$p > .05$ on all comparisons using Independent sample *t*-tests

The findings from the studies of supplemental tactile and kinesthetic stimulation for preterm infants are inconclusive. Most of the studies that have identified benefits of supplemental stroking have been conducted with preterm infants whose conditions were physiologically stable. Studies examining the immediate responses of physiologically fragile preterm infants to touch suggest that stroking very small preterm infants may lower oxygen levels or promote behavioral agitation. The four studies involving gentle touch without stroking suggest that this type of intervention may have positive effects on very small preterm infants.

Als and colleagues and Becker, Grunwald, and Moorman have identified beneficial effects of a developmental approach to NICU care, including improved behavioral regulation, increased mental and psychomotor development, lower oxygen requirements, and less disorganized movement.[17,18] Becker and colleagues noted that the developmental approach involves a number of different interventions, including providing quiet, firm containment of the infant's trunk and limbs to reduce random movement and promote alertness.[18,19] The gentle touch that was evaluated in the study reported here can be viewed as a modified type of containment.[14] The primary difference between gentle human touch and containment is that the infant's movement was not restrained with the GHT protocol. Becker and colleagues noted that the studies evaluating the developmental care model have not examined the effectiveness of each of the individual components of the model.[19]

The study described here allowed evaluation of preterm infants' physiologic and behavioral responses to a discrete gentle human touch intervention so that NICU nurses might have a basis for guiding parents in their early interactions with hospitalized preterm infants. Facilitating a positive experience and promoting parent-infant contact during these early interactions can enhance the development of parent-infant attachment.

TABLE 2 ■ Selected Characteristics of Experimental and Control Group Infants

Variable	Number of Infants	
	Experimental Group	Control Group
Gender		
Male	8	10
Female	7	5
Race		
Caucasian	5	4
African American	10	11
Cesarean section		
Yes	5	5
No	10	10
Intraventricular hemorrhage		
None	6	8
Grade 1	3	2
Grade 2	3	4
Grade 3	3	1
Gestational age at birth (weeks)		
26–28	2	2
29–30	5	3
31–32	8	10

Note: $p > .05$ on all comparisons using chi-square analysis procedures

HYPOTHESES

An experimental design was used to test the following hypotheses:

I. Among infants in an experimental group who receive 15 minutes of GHT daily for 5 days:
   A. There will be no significant change in oxygen saturation or heart rate levels before, during, and after periods of GHT.
   B. There will be an increased percentage of quiet sleep and a decreased percentage of active sleep during periods of GHT compared with baseline and post-touch periods.
   C. There will be decreased levels of motor activity and fewer behavioral signs of distress during periods of GHT compared with baseline and post-touch periods.

II. Compared with infants in a randomly assigned control group, infants who receive supplemental GHT will demonstrate:
   A. Lower morbidity scores
   B. Fewer days receiving supplemental oxygen
   C. Fewer days receiving phototherapy
   D. Increased average daily weight gains
   E. More optimal patterns of behavioral organization
   F. Decreased levels of motor activity
   G. Decreased levels of behavioral distress
   H. A greater percentage of quiet sleep

METHODS

Sample

The sample consisted of 30 preterm infants who were hospitalized in a Level III NICU at a regional medical center in a southern city. The sample included infants who met the following criteria: (1) gestational age between 26 and 32 weeks at birth, (2) no congenital anomalies, (3) no surgery, (4) not receiving pancuronium bromide (Pavulon), (5) no medical orders contraindicating the administration of GHT, and (6) mothers not known substance abusers.

TABLE 3 ■ Postconceptional Age When GHT Sessions Began

Postconceptional Age (weeks)	Number of Infants
27–28	2
29–31	5
32–33	8

Tables 1 and 2 illustrate selected characteristics of the infants in the experimental and control groups. There were no significant differences between the groups (at an *alpha* level of .05) on any of these characteristics.

Procedures

The study was approved by the Institutional Review Boards of the university and the hospital where the data were collected. Parents of infants who met the sample selection criteria were contacted by one of the researchers when the infants were between two and six days old. After parents signed the consent form, infants were assigned randomly to either the experimental (E) or control (C) group. Infants in the C group received the amount of touch associated with usual NICU care. In addition to the usual NICU care, infants in the E group received 15 minutes of gentle human touch each day for five days, beginning when they were between six and nine days of age. Table 3 illustrates the postconceptional ages of the study group infants at the time of the first GHT session.

Each GHT period was provided by the principal investigator (PI) or a trained research nurse and lasted for 15 minutes. The original protocol specified that the touch would be discontinued if the infant demonstrated signs of physiological distress (heart rate <100 or >200 beats per minute for 12 seconds or more, or arterial oxygen saturation levels <90 percent for longer than 30 seconds) or if it was necessary for the infant's nurse to increase the infant's FiO_2 concentration during the GHT period. None of the infants exhibited these signs of physiological distress during the GHT sessions; thus, it was not necessary to discontinue any GHT session before the end of the 15-minute period.

The GHT was provided according to a protocol (sidebar–GHT Protocol). The protocol was similar to the type of gentle touch used by Jay,[13] the touch was modified to avoid touch on the chest or abdomen that might interfere with chest excursion and included the instruction to terminate touch if the infant exhibited physiological indices of distress.

All GHT interventions were provided between 9 AM and 11 PM to control for possible influences of circadian rhythms on

GHT Protocol

1. The infant was in a prone position.
2. The researcher scrubbed her hands and arms for three minutes with an antiseptic solution according to NICU protocol using warm water. An electronic thermometer was used to check that the researcher's hand was at least 34°C prior to initiating the GHT.
3. The researcher sat on the side facing the infant so that she could observe the infant's eyes to identify rapid eye movement (REM) sleep. The researcher did not talk to the infant during GHT sessions.
4. The researcher gently placed one hand on the infant's head and the other across the infant's lower back and buttocks, being careful not to touch any intravenous tubing or skin sensors. The touch was maintained for 15 minutes. To provide touch with an equivalent amount of pressure during all GHT episodes, the researcher stood or sat on an adjustable stool at the infant's bedside so that her elbows were level with the infant's mattress or the incubator portholes. The researcher initially placed her hands on the infant without exerting pressure from the weight of her arms. Within 30 seconds of the initial contact, the researcher relaxed her arms, so that the amount of force received by the infant was based on the weight of the researcher's relaxed arms.

Data Collection Protocol for Experimental and Control Group Infants

1. On days 6–8 of life and again on the days 12–14 of life, each infant was observed for 30 minutes to assess baseline sleep-wake patterns and activity levels and levels of behavioral distress.
2. Infant morbidity status was assessed each day throughout the study using a revised version of the Neonatal Morbidity Scale (NMS).[28]
3. Information about the following parameters was recorded daily throughout each infant's hospital stay, on the basis of chart review: caloric intake, weight, elimination patterns, and medical treatments (supplemental oxygen, phototherapy, transfusions, antibiotics, sedatives). Interrater reliability of these measures was assessed throughout the study and averaged 98 percent.
4. Once the infants were physiologically stable (no longer requiring intravenous feedings or supplemental oxygen, and nursed in an open crib), their behavioral organization and reflexes were assessed by one of the co-investigators using the Brazelton Neonatal Behavioral Assessment Scale (BNBAS).[29] The co-investigator did not know the infants' treatment group assignments.

the infants' responses, but to still allow flexibility for data collection in the event that two infants were enrolled in the study at the same time.[20] Because non-nutritive sucking can influence physiological as well as behavioral measures, infants were not offered pacifiers during the data collection periods.[21,22]

Before initiating the GHT intervention, the researcher set up the data collection equipment at the infant's bedside. A Compaq portable computer was interfaced with a Nellcor pulse oximeter, a Corometrics cardiac monitor, and a Panasonic portable video, using the same system used in a previous study conducted by the principal investigator to examine the effects of parent touch on preterm infants.[23] All equipment was mounted on a portable data collection cart. The portable video camera was mounted on an adjustable stand that could be rolled to the bedside.

Baseline data on heart rate and oxygen saturation levels were collected every six seconds for ten minutes from the Nellcor and Corometrics monitors. A ten-minute videotape was made at the same time to record baseline behavioral state, behavioral signs of distress, and activity levels. Physiological and videotape data were collected throughout the GHT episode and for a ten-minute post-touch period. To conserve the infant's energy and limit carryover effects from previous handling, no baseline data collection began until at least ten minutes had elapsed following any previous handling episode.

The data collection protocol illustrates the data collected during the study infants' hospital stays to assess their morbidity status and developmental outcomes (sidebar–Data Collection Protocol for Experimental and Control Group Infants).

Instrumentation

Infants' *arterial oxygen saturation levels* were assessed using a Nellcor pulse oximeter. *Heart rates* were assessed using a neonatal Corometrics cardiac monitor. The oximeter measures the percentage of hemoglobin oxygen saturation and has been shown to correlate closely with readings of transcutaneous oxygen pressure, arterial oxygen pressure, and arterial oxygen saturation.[24,25] The data collector assessed the reliability of these measures at the beginning of each data collection period by ensuring that there was (1) an adequate EKG tracing on the cardiac monitor and (2) ensuring that there was no more than a five-beats-per-minute difference in the heart rates recorded on the pulse oximeter and the cardiac monitor.

Activity levels, behavioral signs of distress, and *behavioral state* were coded using the system developed by Scafidi and colleagues.[26] The following motor activities were coded: single-limb, multiple-limb, and gross body movements; headturns; and startles. A time-sampling method was used, with 15-second observations followed by 15-second recordings throughout the baseline, touch, and post-touch periods. The researcher recorded the behaviors at the bedside during baseline and post-touch periods. During the touch period, the researcher spoke softly into a video recorder microphone describing the infant's behav-

TABLE 4 ■ Results of Repeated Measures Multivariate Analysis of Variance (MANOVA) Procedures Comparing Oxygen Saturation and Heart Rate Levels Before, During, and After GHT

	Mean (Standard Deviation)				
Variable	Baseline	Touch	Post-touch	*F*	Sample Probability of *F*
Oxygen saturation	96.6 (2.4)	97 (2.9)	97.7 (1.6)	1.37	.293
Heart rate	151.7 (6.2)	150.9 (6.2)	151.6 (5.8)	0.7	.515

Note: n = 14 (because there was missing heart rate and physiological data for one infant in the GHT group), *df* = 2,11

TABLE 5 ■ Results of Repeated Measures MANOVA Procedures Comparing Percentage of Quiet and Active Sleep, Motor Activity, and Behavioral Distress Before, During, and After GHT

	Mean (Standard Deviation)				
Variable	Baseline	Touch	Post-touch	*F*	Sample Probability of *F*
Quiet sleep	53.7 13.1	60.8 (16.3)	55.3 (14.3)	1.73	.22
Active sleep	18.9[a] (10.1)	9.9[b] (6.4)	17.9[a] (8)	7.16	.008
Motor activity	86.6[a] (28.5)	63.9[b] (19.4)	80.2[a] 23.2)	9.68	.003
Behavioral distress	68.2[a] (17.7)	53.7[b] (19.7)	68.5[a] (19.5)	4.49	.033

[a,b] Indicates contrasts that are significantly different ($p < .05$), *df* = 2,13

iors; the behaviors were subsequently coded from these videotaped recordings. Any category of motor activity or behavioral distress that occurred during the 15-second observation period was coded. The behavioral state that occurred during the majority of the interval was coded. A total motor activity score was calculated by summing the percentages from each motor activity category. The coded behavioral distress signs included mouthing/yawning movements, facial grimaces, and clenched fists. A total behavioral distress score was calculated by summing the percentages from each behavioral distress category. Coded behavioral states included quiet sleep, active sleep, REM sleep (active or quiet), drowsy, inactive alert, active alert, and fussing/crying. The interrater reliability of the categories reported by Scafidi and colleagues ranged from 0.70 (smiles) to 0.99 (fussing/crying).[26] Interrater reliabilities were assessed 14 times throughout the study by having two observers independently code an observational session. The overall mean percentage agreement for all categories throughout the study was 95 percent; the mean reliabilities for individual behaviors ranged from 0.81 (single-limb movement) to 1 (fuss/cry).

Gestational age at birth was measured by one of the research nurses using the Ballard Maturational Score.[27] To ensure consistency in the procedures used to assess gestational age, the Ballard examination score was used rather than basing the estimate of gestational age on the mother's expected date of confinement.

Morbidity status was measured by a revised version of the Neonatal Morbidity Scale (NMS), which was originally developed by Minde and colleagues.[28] This scale was revised and used in the PI's previous parent touch study.[23] Content validity of the revised scale was confirmed by two neonatologists, two perinatal clinical nurse specialists, and one neonatal nurse practitioner. The revised NMS consists of 18 items describing various medical complications that might affect preterm infants (e.g., hydrocephalus, apnea, respiratory distress). Each item is rated on the basis of chart review using a one-to-three-point scale, with higher scores reflecting more serious complications. Interrater reliability in this study was assessed using the percentage agreement method and averaged 98 percent throughout the study.

Behavioral organization was assessed by one of the researchers who is a trained examiner, after the infants reached 36–38 weeks postconceptional age or were physiologically stable, using the Brazelton Neonatal Behavioral Assessment Scale (BNBAS).[29] The mean postconceptional age at the time of BNBAS testing was 37.5 weeks. The BNBAS consists of 37 items that are rated on a nine-point scale and 20 reflex items that are scored as "normal" or "abnormal." The scale was scored using a cluster-scoring system described by Lester, Als, and Brazelton.[30] It yielded measures of the following factors: range of state, state regulation, motor behavior, autonomy, stability, habituation, and orientation. Interrater reliability on this scale was assessed on 17 percent of the examinations using a percentage agreement method. Scores that were within one point of each other were counted as agreements. Interrater reliability averaged 85 percent.

FINDINGS

The study hypotheses were tested using SPSSX software on the University of Alabama's mainframe computer. Hypothesis IA predicted that, among infants in the E group who received GHT, there would be no change in oxygen saturation or heart rate levels before, during, or after periods of GHT. Results indicated that there was no significant difference in oxygen saturation or heart rate levels before, during, or after GHT periods (Table 4).

Hypothesis IB predicted that there would be an increased percentage of quiet sleep and a decreased percentage of active sleep during periods of GHT compared with baseline and post-touch periods. Hypothesis IC predicted that there would be decreased levels of motor activity and behavioral distress

TABLE 6 ■ Results of One-Way ANOVA Procedures Comparing Infants in the GHT and Control Groups

Variable	Mean (Standard Deviation) Touch Group n = 15	Control Group n = 15	*F*	Sample Probability of *F*	*df*
Average morbidity score*	1.86 (0.79)	1.96 (1.1)	0.09	.77	1,28
Total morbidity score—days 6–14 postbirth	24.27 (13.1)	24.47 (18.69)	0.001	.97	1,28
Number of days on supplemental oxygen	1 (3.1)	4.67 (12.77)	0.17	.29	1,28
Average number of days on supplemental oxygen*	0.02 (0.07)	0.06 (0.16)	0.78	.38	1,28
Number of days on phototherapy	6.27 (1.94)	4.6 (1.96)	5.47	.03	1,28
Average days on phototherapy*	0.14 (0.05)	0.09 (0.05)	5.43	.03	1,28
Average daily weight gain (gm)	16.43 (2.85)	16.9 (3.24)	0.18	.67	1,28
BNAS cluster scores					
a. Habituation	5.4	5.1	0.35	.56	1,26
b. Orientation	5.6	5.3	0.15	.70	1,27
c. Motor maturity	5.3	5.8	2.64	.12	1,27
d. Range of state	3.8	3.7	0.09	.76	1,27
e. State regulation	4.5	4.8	0.44	.51	1,27
f. Autonomic stability	7	7.1	0.02	.89	1,27

* Averages were calculated by dividing the value of the variable by the number of days the infant was hospitalized.

during GHT compared with baseline and post-touch periods. Table 5 presents results from the statistical analysis used to test these hypotheses.

Although there was no significant difference in the percentage of quiet sleep comparing baseline, touch, and post-touch periods, there was significantly less active sleep during periods of GHT compared with baseline and post-touch periods. There was significantly less motor activity and behavioral distress during GHT sessions than during baseline or post-touch periods.

Hypotheses IIA–IIE addressed comparisons between infants in the E and C groups on five outcome variables (Table 6). Contrary to expectations, infants in the E group spent more days receiving phototherapy than did infants in the C group. There were no differences between infants in the E and C groups on morbidity scores, numbers of days on supplemental oxygen, weight gain, or BNBAS scores.

Table 7 presents the results from analyses used to test Hypotheses IIF–IIH, comparing E and C infants on the percentage of motor activity, behavioral distress, and quiet sleep at time 1 (age 6–8 days) and time 2 (age 12–14 days) during 30-minute observations. There were no differences between E and C group infants in the percentage of motor activity, behavioral distress, or quiet sleep during the 30-minute observations at time 1 or 2. However, there was a significant decrease in the percentage of quiet sleep for all infants from time 1 to time 2.

CONCLUSIONS/DISCUSSION/RECOMMENDATIONS

The results from this study suggest that a 15-minute GHT intervention has no adverse effect on the heart rate or oxygen saturation levels of small preterm infants. This type of touch seems to have a soothing effect on these infants, as evidenced by a decreased level of active sleep, motor activity, and behavioral distress.

The finding that infants in the experimental group spent more days receiving phototherapy than did infants in the control group was unexpected. Phototherapy days is not a measure usually examined in studies evaluating the effects of tactile stimulation on preterm infants. We decid-

TABLE 7 ■ Results of Repeated Measures ANOVA Procedures Comparing E and C Infants at Time 1 (Age 6–8 Days) and Time 2 (Age 12–14 Days) on Percentage of Motor Activity, Behavioral Distress, and Quiet Sleep During 30-Minute Observations

	Time 1		Time 2		F (Probability) for Effect of		
Variable	E	C	E	C	Group	Time	Group × Time
Mean percent of motor activity	78.3	70	84.9	84.9	0.24	1.9	0.27
Standard deviation (SD)	(24.6)	(28.9)	(38.2)	(33.7)	(0.63)	(0.18)	(0.60)
Mean percent of behavioral distress	68.9	61.2	62.5	66.3	0.07	0.01	0.67
(SD)	(27.9)	(27.9)	(33)	(25.1)	(0.79)	(0.92)	(0.42)
Mean percent of quiet sleep	61	62.7	48.3	45.5	0	20.6	0.45
(SD)	(9.05)	(16.9)	(21.9)	(18.3)	(0.92)	(.000)*	(0.509)

* Statistically significant

ed to include this variable because our study was exploratory and we were interested in identifying any possible effects of the gentle touch intervention on the infants in the study. Further research is needed to determine whether this finding is replicated.

There are several possible explanations for the findings that there were no differences between infants in the E and C groups on any of the other outcome variables that were measured. One explanation is that this type of tactile stimulation does not have any long-term effects on an infant's morbidity status or developmental outcome. Another possible explanation is that the length of the GHT intervention used in this study (only 15 minutes per day for five days) was too brief to result in any benefits for the E group infants. We are currently conducting a four-year follow-up study (funded by the National Institute of Nursing Research) in which E group infants receive the GHT intervention for 10 minutes, three times a day, for ten days. The interventions begin when the infants are six to nine days old. The results from this follow-up study will indicate whether a more intensive GHT intervention results in long-term benefits for the infants.

The finding that the percentage of quiet sleep decreased from time 1 to time 2 was also unexpected based on results from other research, which suggest that the percentage of quiet sleep increases during the early weeks of life in preterm infants.[31] The percentage of quiet sleep observed in this study was also higher than that reported in other studies.[31] One explanation for this finding may be that we recorded the sleep state that was present during the majority of the 15-second interval. Other methods of coding behavioral state may result in different findings.

Although any type of stimulation provided to preterm infants should be based on each infant's individual responses, the results of this study suggest that NICU nurses can encourage parents to use gentle touch when handling their small preterm infants in the NICU during the early weeks of life. Replication of this study with a larger sample may help to determine whether more intensive GHT intervention results in long-term benefits for hospitalized preterm infants. (5)

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About the Authors

Lynda Harrison is a professor and director of research at the University of Alabama, Capstone College of Nursing, Tuscaloosa. She is a member of the Research Committee of the National Association of Neonatal Nurses and is certified in the administration of the Brazelton Neonatal Behavioral Assessment Scale.

Linda Olivet is associate professor and assistant dean for clinical affairs at the University of Alabama, Capstone College of Nursing, Tuscaloosa. She is certified in the administration of the Brazelton Neonatal Behavioral Assessment Scale.

Kathy Cunningham was an undergraduate student research assistant on this project when the study was conducted.

Mary Beth Bodin is a neonatal nurse practitioner in the neonatal intensive care unit at DCH Regional Medical Center in Tuscaloosa, Alabama.

Cindy Hicks is a staff nurse in the neonatal intensive care unit at DCH Regional Medical Center in Tuscaloosa, Alabama.

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For further information, please contact:
Lynda Harrison, RN, PhD
Professor and Director of Research
University of Alabama
Capstone College of Nursing
Box 870358
Tuscaloosa, AL 35487-0358