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Effect of the Artificial Night with Facilitated Tucking and Artificial Night Alone on the Physiological Indices of Premature Infants

Akram Raie Ezabadi[1], Khadije Dehghani[2*], Hosein Fallahzade[3]

1. Neonatal Intensive Care Unit, Faculty of Nursing and Midwifery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
2. Faculty of Nursing and Midwifery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
3. Research Center Of Prevention and Epidemiology, Health Faculty, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

ABSTRACT

Background: Preterm birth and admission to neonatal intensive care unit as stressors can cause physiological instability that may lead to prolong hospitalization and mortality. This study aimed to determine the effect of artificial nights and facilitated tucking on the physiological indices of premature infants.

Methods: This randomized clinical trial was conducted on 60 preterm infants admitted to the neonatal intensive care unit at Shohadaye Kargar Hospital in Yazd, Iran, during 2017-18. The infants were selected through a convenient sampling method, and were randomly assigned into three groups of artificial nights with facilitated tucking (group 1) (n=20), artificial nights (group 2) (n=20) and control group (group 3) (n=20). Subsequently, the physiological indices (i.e., heart rate, respiration rate, arterial oxygen saturation) were measured twice a day at 7:00 a.m. and 19:00 p.m. for 3 days. The data were analyzed in SPSS software (version 20). A p-value less than 0.05 was considered statistically significant.

Results: There was a significant difference among the three groups in terms of mean values of heart, respiratory, and arterial oxygen saturation rates ($P<0.05$). The first experimental group obtained a greater reduction in heart rate and respiratory rate on the third day (at 19:00 p.m.), as well as a greater increase in arterial oxygen saturation rate on the second (at 19:00 p.m.) and third days (at 7:00 a.m. and 19:00 p.m.), compared to the other two groups ($P<0.05$). Additionally, , the mean value of heart and respiratory rates were lower and arterial oxygen saturation rates were higher in the intervention group 1, compared to the other groups.

Conclusion: According to the results of the study, the simulation of the mother's womb environment through creating artificial night and maintaining facilitated tucking resulted in the improvement of physiological indices of the premature infants. Furthermore, artificial night together with facilitated tucking leads to better results, compared to artificial night alone.

Keywords: Artificial night, Facilitated tucking, Physiological indices, Premature infant

Introduction

The life chances for preterm infants have increased along with significant advances in neonatal medicine in recent decades. The statistics in Iran indicate that 5000 infants are born each day, 12% of whom are premature. In the US, 250,000 preterm infants are born each year which constitute 8.8% of the births (1). The challenge regarding preterm infants nowadays is not only about their survival and their fate but also their neurodevelopment process. These infants should spend this period in their mothers' wombs which are an adjusted environment with appropriate temperature, light, noise, and movements (2). Preterm birth as a stressor can cause behavioral and developmental problems, as well as prolonged hospitalization and mortality (3).

Inappropriate stimuli in the neonatal intensive care unit (NICU), such as continuous and excessive light and inappropriate position cause stress in infants in a way that lead to an increase in

* *Corresponding author*: Khadije Dehghani, Faculty of Nursing and Midwifery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. Tel: 09131535531; Email: dehghanish@ssu.ac.ir.

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wakefulness, restlessness, reduced sleep, and changes in vital signs beyond the expected range. The foregoing changes may lead to alterations in the physiological performance of the body which results in infant's need for medical or nursing care. Vital signs as physiological indices can give us information on health status and infant's responses to physical and mental tensions, medical treatments, and nursing care (4, 5). Neonatal individual developmental care assessment program (NIDCAP) is a method emphasizing the development of the fetus and the infant. Based on this care program, the infant is helped for reducing the negative effects of environmental factors, such as noise pollution, unfavorable visual stimulations, and inappropriate position. The use of new care principles based on the improvement of infant development and providing optimal services are the duties of nurses working at NICUs (6, 7).

Preterm infant's eyelids cannot completely protect the retina against light sources. By placing a cover on the incubator (artificial night), the infant's eyes can be protected from direct light, which helps to create a circadian rhythm that is important for development and adaptation to home care and healthy sleep cycles (3, 8).

Facilitated tucking is another subcategory of NIDCAP care in a way that the infant is placed in flexed, midline, and in different positions (i.e., side and prone), and the position reminds the infant of his/her development in the uterus (9, 10). This technique enables self-control and self-calming in the infant, and by supporting the infant, it creates synchronization in the sensory, tactile, thermal, and motor systems (11). According to the findings, this type of limiting has had positive effects on physiological changes (2, 3). Studies have indicated that artificial night (12) and facilitated tucking (13, 14) could separately have positive effects on the infant's physiological indices. However, the results of a study indicated that facilitated tucking alone had less effects than its combination with oral sucrose (15). Moreover, another study revealed that artificial night had a small or no effect on some parameters (16).

The variations in the results of different studies may be due to differences in the number of samples and method of study. Based on the experiences, this care program is applied in many NICUs; however the creation of artificial night has not been fully implemented yet. On the other hand, it seems to be difficult for nurses to do the facilitated tucking during the artificial nights for babies. Therefore, this study investigated the effect of creating an artificial night with facilitated tucking on physiological indices in preterm infants, compared to artificial night alone. It should be noted that the combined effects of these two methods have not been examined on the physiological indices of preterm infants. If the creation of an artificial night alone will be as effective as an artificial night with the facilitated tucking, it can be used solely.

Methods

This randomized clinical trial included all preterm infants qualified for hospitalization at NICU in Shohadaye Kargar Hospital, Yazd, Iran, from October 2017 to April 2018. This hospital is affiliated to the Social Security Organization.

Considering the significance level of 5%, test power of 80%, the results of similar studies (12), as well as standard deviation S=5.5, and for achieving the minimum significant difference as much as 5 units in the mean of respiration rate in three groups, the sample size was obtained to be 16 individuals in each group. After adjusting for 10% percent possible dropout, the sample size was estimated as 20 individuals for each group.

$$n = \frac{(z^{\alpha}/_2 + z_{\beta})^2 \times 2s^2}{(x_1 - x_2)^2}$$

The inclusion criteria were: 1) preterm infants hospitalized at NICU, 2) 5-minute Apgar score equal to or higher than 7, 3) gestational age of 32-36 weeks, 4) respiratory score of lower than 5, and 5) utilization of gavage feeding. On the other hand, the infants of an addicted mother, and those who were restless and needed phototherapy and surgery, and had other diseases, such as cardiac disorders, birth defects, and metabolic diseases were excluded from the study.

Furthermore, the attrition criteria were: 1) apnea (Apnea requiring advanced treatment), 2) increased respiratory score, 3) initiation of feeding directly from mother's breast, and 4) phototherapy. First, the infants were identified considering the inclusion criteria. Overall, 60 infants were randomly assigned into three groups (20 infants per group) using a draw method. The randomization process was as follows: after shaking the box containing the cards, a card was taken out, and based on the card title, the infants were distributed among the three groups.

The first group consisted of infants who were placed under artificial nights and facilitated tucking (n=20), and the second group was formed by infants who were given care under artificial night conditions (n=20). Moreover, the third group was the control group (n=20) whose members were given routine care in the ward and received no intervention. After at least 12 h following the birth and ensuring the respiratory stability and lack of restlessness of the infant, the infants were studied for 3 days in all groups.

In order to create artificial night (i.e. periodic light), a two-layered cover was used in groups 1 and 2 that was placed on the incubator from 19:00 p.m. to 7:00 a.m. and removed from the incubator in the light period from 7:00 a.m. to 19:00 p.m. Furthermore, for maintaining facilitated tucking (C shape position) in group 1, a soft towel was used with medium flexibility from 7:00 a.m. every day for 3 days. In addition, the researcher would place the infant in stomach or side position while his/her hands and feet were brought towards the body, and the hands were near face and mouth.

Infant physiological indices (i.e., respiratory rate, heart rate, and arterial oxygen saturation rate) were monitored twice a day at 7:00 a.m. and 19:00 p.m. by the researcher. It should be noted that in group 1 and 2, the monitoring time was at 7:00 a.m. just before removing the cover from the incubator, and at 7:00 p.m. just before placing the cover on the incubator. At the same time, the infants in the control group were also monitored.

Sa'adat Monitors (model S1800) was used in order to study heart rate and arterial oxygen saturation rate in the moment, and the probe of the monitor was attached to the infant's right hand. In order to accurately register respiratory rate in a complete minute, a calibrated chronometer (Digital Timer) was also employed in this study. The infants' body temperature was maintained at the normal range of 36.5-37.3°C by controlling environment temperature and incubator. Double-layered incubators were used in order to reduce the confounding factor of noise as a stressor for the infants.

The data were collected using recorded information derived from patients' file covering such information as respiratory score, Apgar score, the infants' gestational and chronological age, and birth weight along with a sheet to record physiological indices (i.e., heart rate, respiratory rate, and arterial oxygen saturation rate). A gavage method with breast milk was used to feed the infants in all groups every 2 h. The data were analyzed in SPSS software (version 20) through Kolmogorov-Smirnov, analysis of variance (ANOVA), repeated measures ANOVA, and Tukey's test. A p-value less than 0.05 considered statistically significant.

Results

There were 16 dropouts in the number of infants, including 3 cases due to direct breastfeeding initiation (1 and 2 cases in control and the first group, respectively) and 13 cases due to physiotherapy initiation (8 and 5 cases in the first and second groups, respectively). Sampling was continued until the completion of samples, and in total, 20 subjects were included in each group.

The results of Kolmogorov-Smirnov test indicated that the data related to gestational age, Apgar score, respiratory score, and weight were normally distributed among the studied groups (P>0.05) (Table1). Moreover, according to ANOVA, no significant difference was found among the three groups in terms of gestational age, Apgar score, respiratory score, and weight before entering the study (P>0.05). The results of ANOVA also revealed a significant difference among the three groups regarding the mean value of respiratory rate at 7:00 a.m. and 19:00 p.m. on the third day of the intervention (P=0.001 and P=0.014) (Table2).

Furthermore, the results of the post hoc Tukey's test showed a significant difference between groups 1 and 3 in terms of the mean value of respiratory rate on the third day of the intervention at 7:00 a.m. and 19:00 p.m., and also between group 1 and 2 at 19:00 p.m. (P<0.05).

In other words, mean value of respiratory rate in group 1 was lower than that in groups 2 and 3,

Table 1. Comparison of the intervention and control groups in terms of demographic characteristics

Demographic characteristics	Artificial night with facilitated tucking group	Artificial night group	Control group	P-value
	Mean ±standard deviation	Mean ±standard deviation	Mean ±standard deviation	
Respiratory rate	0.858±3	0.858±3	0.887±3.05	0.977
Apgar score	9.45±0.759	9.3±0.733	9.3±0.733	0.688
Gestational age (weeks)	34.15±0.1.226	34.15±0.1.226	34.1±0.1.252	0.987
Weight	2400±150	2350±123	2420±145	0.85
Chronological age (hours)	24±2.34	23±3.45	22±5.6	0.56

Table 2. Comparison of the three studied groups in terms of mean respiratory rate at the measurement times during the intervention

Respiration		group			P-value
		Group 1 Artificial night and facilitated tucking	Group 2 Artificial night	Group 3 Control	
7 AM 1	Mean Standard deviation	70.85 11.82	69.45 11.30	69.70 11.94	0.922
7 PM 1	Mean Standard deviation	67.75 10.5	68.05 10.99	68.50 11.60	0.977
7 AM 2	Mean Standard deviation	61.75 9.27	64.9 10.84	66.95 11.70	0.306
7 PM 2	Mean Standard deviation	59.35 9.4	63.55 10.15	65.60 11.08	0.154
7 AM 3	Mean Standard deviation	55.2 7.81	60.1 9.71	64.05 10.06	0.014
7 PM 3	Mean Standard deviation	51.3 7.38	57.9 8.49	62.45 9.32	0.001

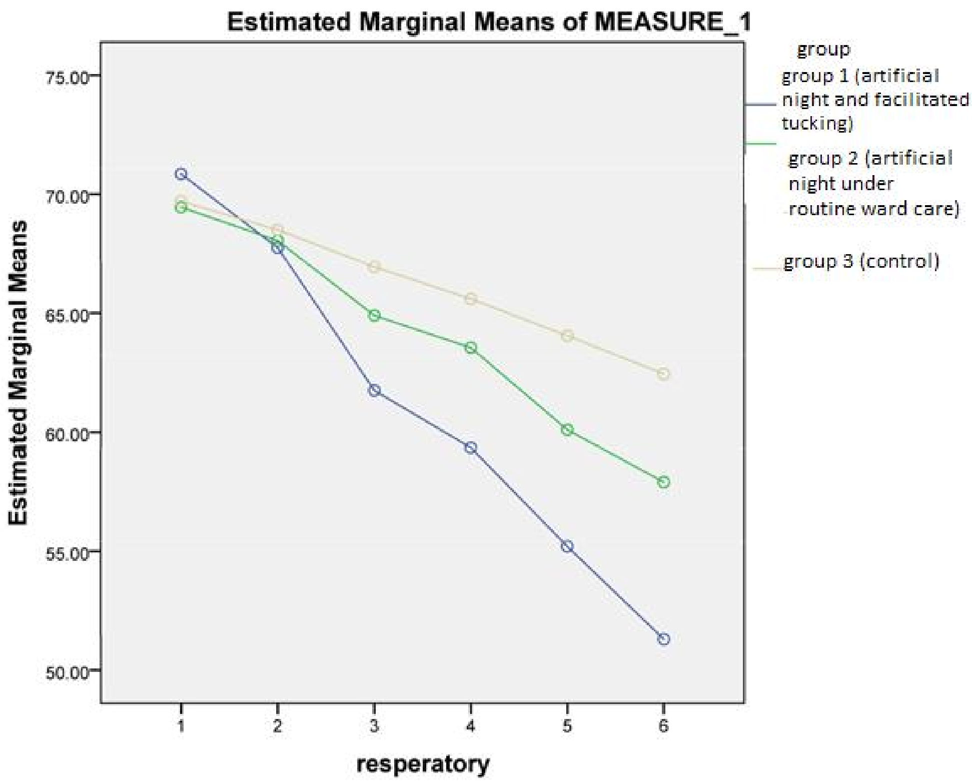

Chart 1. Changes in the mean respiratory rate among the three studied groups at different measurement times

whereas there was no significant difference between groups 2 and 3 regarding mean value of respiratory rate (P>0.05). Considering the repeated measures ANOVA results, it was revealed that the changes in the respiratory rate over time were significantly regardless of the group type. Moreover, the change trend was different among the studied groups (P=0.001) (Chart 1).

The results of ANOVA indicated a significant difference among the three groups regarding the mean value of heart rate at 7:00 a.m. and 19:00 p.m. on the third day (P=0.001 and P=0.011) (Table3). Furthermore, according to the results obtained from the Tukey's test, a difference was observed between groups 1 and 3 in terms of the mean values of heart rate on the third day of intervention at 7:00 a.m. and 19:00 p.m., and also between groups 1 and 2 at 19:00 p.m. (P<0.05).

In other words, the mean value of heart rate in group 1 was lower than that in groups 2 and 3, whereas there were no significant statistical differences between groups 2 and 3 in this regard

Table 3. Comparison of the three studied groups in terms of mean heart rate at the measurement times during the intervention

Heart rate		Group 1 Artificial night and facilitated tucking	Group 2 Artificial night	Group 3 Control	P-value
7 AM 1	Mean Standard deviation	143.40 11.96	141.85 13.19	143.30 14.60	0.922
7 PM 1	Mean Standard deviation	139.55 11.65	140.85 13.35	142.10 14.09	0.827
7 AM 2	Mean Standard deviation	135.75 10.23	140.70 12.05	143 12.58	0.142
7 PM 2	Mean Standard deviation	132.20 10.27	137.80 12.53	140.60 12.00	0.076
7 AM 3	Mean Standard deviation	128.95 9.052	134.80 10.00	139.20 11.86	0.011
7 PM 3	Mean Standard deviation	123.25 8.01	132.35 10.92	138.20 11.30	0.001

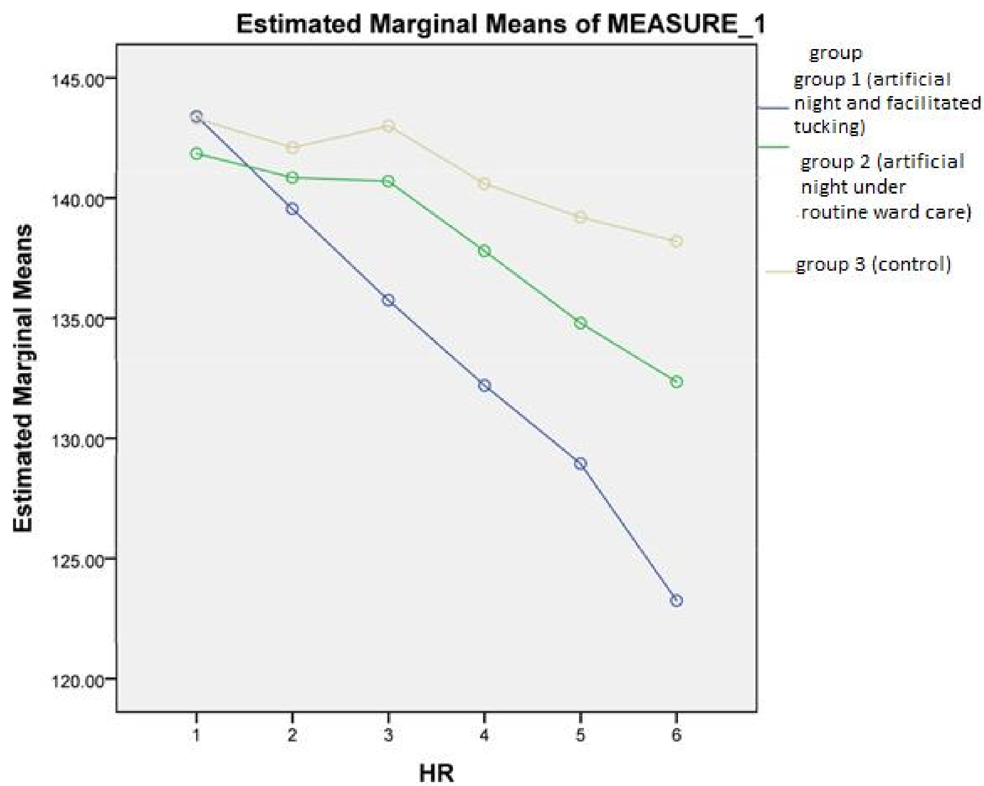

Chart 2. Changes in the mean heart rate among the three studied groups at different measurement times

(P>0.05). Considering the results of repeated measures ANOVA, it was revealed that the changes of heart rate over time were significantly regardless of the group type. Moreover, a difference was revealed among the studied groups in terms of the trend of change (P=0.001) (Chart 2).

The results of ANOVA indicated a significant difference among the three groups in terms of arterial oxygen saturation levels on the second (P=0.011) and third days (P=0.03 and P=0.001) (Table4). In addition, the results of the Tukey's test indicated a difference between groups 1 and 3 in terms of the arterial oxygen saturation levels on the second day at 19:00 p.m. (P=0.01). Moreover, this difference was observed between groups 1 and 2 (P-value<0.05) and groups 1 and 3 (P-value=0.001 and P-value=0.009) on the third day at 7:00 a.m. and 19:00 p.m. In other words, arterial oxygen saturation level in group 1 was significantly higher than that in groups 2 and 3, whereas there were no significant statistical

Table 4. Comparison of three studied groups in terms of mean arterial oxygen saturation at the measurement times during the intervention

Arterial oxygen saturation		Group 1 Artificial night and facilitated tucking	Group 2 Artificial night	Group 3 Control	P-value
7 AM 1	Mean	91.10	91.15	91.35	0.926
	Standard deviation	2.02	1.98	2.36	
7 PM 1	Mean	93.05	92.40	92.45	0.513
	Standard deviation	1.66	1.81	2.35	
7 AM 2	Mean	93.55	92.85	92.55	0.216
	Standard deviation	1.46	1.81	2.13	
7 PM 2	Mean	95.05	94	93.70	0.011
	Standard deviation	1.31	1.37	1.59	
7 AM 3	Mean	95.50	94.30	94.30	0.001
	Standard deviation	0.88	1.21	1.52	
7 PM 3	Mean	97.15	95.55	94.85	0.001
	Standard deviation	0.93	0.99	1.26	

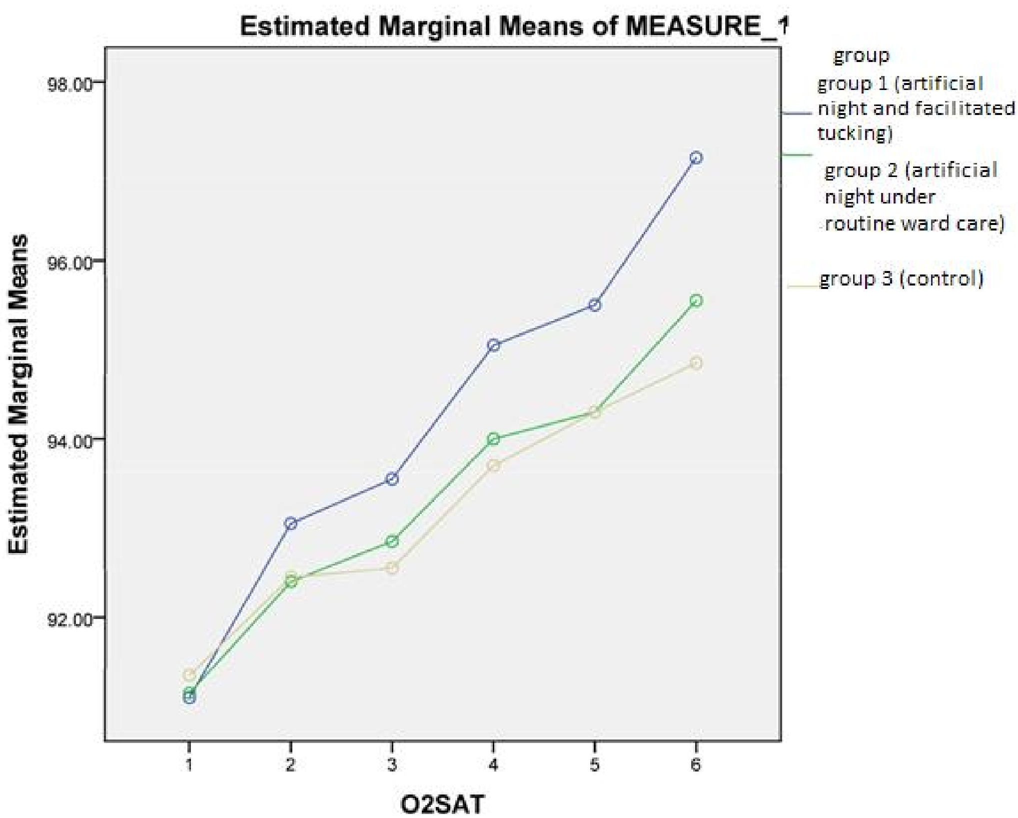

Chart 3. Changes in the mean arterial oxygen saturation among the three studied groups at different measurement times

differences between groups 2 and 3 in terms of arterial oxygen saturation level (P>0.05). Considering the results of repeated measures ANOVA, it was revealed that the changes of arterial oxygen saturation level over time was significant regardless of the group type. Moreover, there was a difference among the studied groups in terms of the trend of change (P=0.001) (Chart 3).

Discussion

In this study, there were significant differences among the three groups in terms of the changes in physiological indices. In the intervention group 1, the mean value of heart and respiratory rates were lower and arterial oxygen saturation rates were higher than those in the other two groups. Therefore, all hypotheses of the study suggest a difference among the three groups in terms of mean values of respiratory , heart, and arterial oxygen saturation rates during verifying the intervention.

There was also a decrease in the mean values of respiratory and heart rates and an increase in arterial oxygen saturation in all three groups during 3 days. This can be due to the effect of time on the cardiovascular and respiratory stability. However, a significant difference was found between the first group and the other two groups after the continuation of the intervention. It simply indicated the remarkable effect of artificial night with facilitated tucking on the improvement of the physiological indices of the premature infants.

It should be noted that the combined effects of artificial night and facilitated tucking has not been investigated in other studies; therefore, there was no possibility to compare their results with the findings of the present study.

Reyhani et al. (2014) conducted a study to examine the effect of artificial night on physiological changes in preterm infants. They indicated that the respiratory and heart rates were lower and the arterial oxygen saturation rates were higher in the artificial night group, compared to the control group ($P<0.05$), which were not consistent with the results of the present study (12). In their study, the duration of the intervention was 10 days, and they investigated artificial night effect only. Therefore, it can be concluded that artificial night alone is effective while increasing the duration of the intervention. Moreover, Taheri et al. (2010) in another study, indicated a significant difference in mean value of arterial oxygen saturation percentage after decreasing the intensity of light and noise, compared to the mean value before the intervention ($P=0.048$), which confirmed the results of the present study.

However, no significant difference was observed in the heart rate, which was not consistent with the findings of the present study. According to the findings of this study, the latter contradiction could be due to the time of measuring physiological indices (12:00 to 13:00). Considering the effect of stimuli, such as light and noise as stressors on physiological indices, the results could have been significant by releasing catecholamine (16) probably if the measurement would have been done before noon, when the NICU is more crowded, or if the intervention would have been done longer or with more sample size.

Some studies have shown that facilitated tucking is effective on physiological parameters of newborns during painful procedures (11, 13, 14, 17). Although there are differences in some of the results that can be due to different number of samples and research methods, in general, the facilitated tucking can be used to sooth the newborns. Axelin et al. (2006) revealed that skin-to-skin contact and maintaining facilitated tucking were interventions that had potentials to calm the infant. In addition, when facilitated tucking is maintained, the preterm infants' sleep is increased, physiological parameters stay more fixed, and the infant becomes less restless (11). Therefore, the reduction of light and its periodic adjustment using artificial night, maintaining facilitated tucking position, simulating the intrauterine development period, as well as making self-calming and self-control, reduce stress in the infant (11, 18).

The limitations of the present study included the lack of qualified infants and complete control of the noise at the NICU. The other limitation in this study was the loss of infants due to the lack of phototherapy blankets, and the onset of breastfeeding during the study. Therefore, sampling took longer because of the replacement of the infants.

This study was conducted on infants with gestational age of 32 to 36 weeks and respiratory score less than 5. Further studies are recommended to be carried out on preterm infants aged 28-32 weeks and respiratory score more than 5. In this study, the duration of the intervention was three days. Therefore, the effect of artificial night alone had no significant changes as much as the combination of this method with the facilitated tucking on the physiological indices. Accordingly, more studies are needed in the future in this regard. This study included no groups of facilitated tucking alone; therefore, it is suggested that further research be conducted on this group. This study was extracted from an MA thesis submitted to the Department of Neonatal Intensive Care Nursing and approved by the Ethics Committee of Shahid Sadoughi University of Medical Sciences and Health Services, Yazd, Iran, (IR.SSU.REC.1395.225) and registered at clinical trial website (IRCT20171226038086N1). The objectives of the study and the research procedures were explained to the parents, and they were reminded of the voluntariness of participation in the study. Moreover, they were assured that the lack of participation in the study would have no effects on caring the infant, and the infant would receive routine hospital cares during hospitalization. Furthermore, they were informed of the confidentiality of the information, and subsequently, written informed consent was obtained from each parent.

Conclusion

Considering the results of this study, it seems that employing artificial night together with facilitated tucking in preterm infants can have a higher effect than artificial night alone in reducing heart and respiratory rates and increasing arterial oxygen saturation. These results can be used by nurses to promote the care of preterm infants.

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Conflicts of interest

There are no conflicts of interest regarding the publication of the study.

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