Original Article

The effects of earmuff on physiologic and motor responses in premature infants admitted in neonatal intensive care unit

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Abstract

Background: Continuous high-intensity noise in the Neonatal Intensive Care Unit (NICU) is stressful for premature infants and its reduction is considered as a nursing care. This study aimed to evaluate the effects of earmuffs' use on the physiologic and motor responses of premature infants.

Materials and Methods: This is a clinical trial conducted on 64 premature infants admitted to the NICU, who met the inclusion criteria, and were randomly assigned to study and control groups. Earmuffs were used for premature infants for 2 h in the morning and 2 h in the afternoon for two consecutive days to reduce the noise intensity in the busiest time of the NICU. The group with earmuff (study group) was compared with the control group receiving only routine care. Infants' physiologic and motor responses were observed before, during, immediately, and 1 h after the intervention. Analysis of covariance and repeated measure analysis of variance (ANOVA) were used to analyze the data.

Results: When infants wore the earmuffs, they had significantly higher mean arterial oxygen saturation, the less frequent motor response, and a decrease in their pulse and respiratory rate.

Conclusion: Paying attention to environmental noise can help the patients, especially the neonates in the NICU, and can be considered as a nursing care. Wearing earmuffs can protect premature infants against noise in the NICU and improve their physiological and motor state.

Key words: Intensive care units, Iran, noise, nursing, premature infants

Introduction

Infancy is the period of rapid psychomotor, cognitive, and social development. The first month of life is a critical period in an infant's life as its major adaptation to extrauterine life occurs. A premature infant is one which is born before 37 weeks of gestational age. Prevalence of premature births has increased by 21% from 1990 in developed countries.[1] In Iran, a cross-sectional study in Yasouj estimated the incidence of prematurity and low birth weight as 4-8% and 7.6%, respectively.[2] Based on existing statistics, over 70% of premature births need hospitalization in Neonatal Intensive Care Unit (NICU).[3]

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Medical advances and improvement of care for infants in the NICU have led to higher chance of survival of these infants compared to premature infants born before these years. Despite their higher chance of survival, the likeliness of disturbances in their nervous system development has increased.[4]

Long-term follow-up of these children up to school age or adolescence shows that most of these infants suffer from neurologic, behavioral problems, and also hearing and vision disorders.[5] Sensory overstimulation due to noise pollution has been mentioned as the causes for premature infants' neurologic disorders, especially when the infant takes ototoxic medication or oxygen. Premature infants are frequently exposed to severe sensory stimulation including improper sound frequencies in the extrauterine environment due to the characteristics of the place where they are hospitalized[6] and lack of intrauterine protection.[3] In fact, the imbalance between environmental stimulation and infants' sensory receptor development has been considered as a factor in their nervous and developmental problems.[7] Infants' exposure to sensory stimulation should match their tolerance and degree of development.[8]

In the NICU, noise acts as a stressor and leads to some changes in infants, including increased heart rate, physiologic and behavioral instability, and hearing disorder.[9]

Among the nursing cares, environmental modification positively affects infants' growth and development. Reduction of exposure to sound stimulation in an infant in order to diminish the imposed stress can be achieved through various methods which can be categorized as noise-lowering methods such as behavioral modification through education[10] and noise exposure prevention methods like wearing earmuffs, earplugs, and using sound absorbing foams.[11]

Although infants' overexposure to noise can be risky and previous study showed that noise-lowering programs in the NICU can decrease the imposed stress to infants,[12] unfortunately, the noise is yet high in NICUs in Isfahan; therefore, this study aimed to investigate the effects of wearing earmuff on physiologic and motor responses in premature infants admitted to the NICU as well as NICU nurses' attitude about the use of earmuffs in hospitalized premature infants in order to lower the sound stress imposed to infants in this ward.

Materials and Methods

In a clinical trial, 64 premature infants hospitalized in NICU of Shahid Beheshti Hospital in Isfahan city, Iran, who met the inclusion criteria were enrolled. After agreement of mothers to participate their infants in the study, written informed consent were obtained, the subjects were randomly assigned to study and control groups.

The inclusion criteria were gestational age 28-37 weeks, having Iranian race, APGAR scores ≥7 in the first and the fifth minute after birth, and a normal result of otoacoustic emissions test. Exclusion criteria were infants under mechanical ventilation, derelict infants, existence of brain disorders, congenital anomalies, sepsis, respiratory distress score ≥5, congenital cardiac diseases, and history of drug abuse in mothers. Sampling was conducted from May to August 2012. Mini-muffs were used for the infants in the study group between 9:00 and 11:00 AM and 4:00 and 6:00 PM. The standard earmuffs used in this study, designed for premature infants, especially those hospitalized in NICU, were made by, were made by Nature Company, San carlos USA. These earmuffs, which are laid on infants' external ears, diminish the sound intensity to at least 7 dB and the sound pressure level by over 50%, so that they do not block infants' necessary hearing stimulation for nervous system development. To prevent infection and respect aseptic considerations, a separate pair of earmuffs was used for each infant. Heart rate and arterial O_2 saturation level were assessed by a calibrated pulse oximeter connected to the infants. Respiration rate was measured every minute by observation of the infant. Infants' motor responses including startle, tremor, and twitch were calculated per 15 min by one of the researchers by observation. Assessment and recording of physiologic responses were conducted every 15 min and motor responses were recorded at 15 min before the intervention, during the intervention, and until 1 h after the intervention. In the control group in which no intervention except routine treatments and care were conducted, all parameters were assessed at time intervals similar to the study group. Infants' demographic characteristics were extracted from their medical files.

All data were entered in a data record form. The data relating to the attitude of the staff were collected using a questionnaire designed by Abou Turk *et al*. (2009)[13] after terminating the study. The questionnaire was translated to Persian, underwent minor changes based on experts' indications, and then its validity was investigated and confirmed. The questionnaire reliability was estimated by Crobach's alpha of 0.9. The questionnaire, which had a brief introduction about the complications of noise pollution and the importance of the attitude of the staff about using earmuff in infants, includes two sections: Demographic characteristics and nurses' attitude in relation with earmuffs.

The questionnaire contained nine questions for which the nurses selected one of the following answers: "Never," "sometimes," "often," and "always." Environmental noise intensity was measured and recorded by a calibrated sound level meter device, based on the unit of decibel, laid on the infant's bed at a specific distance from the infant's head during the intervention in the study group and also at similar time intervals in the control group. Data were analyzed by SPSS version 18. Analysis of covariance was used to compare the mean scores of physiologic and behavioral responses in various time points between groups. Repeated measure analysis of variance (ANOVA) was used for comparison of means of variables in various time points in each group. The frequency distribution chart was adopted to define the attitude of the staff about the use of earmuffs in infants

Results

There were 22 male and 10 female infants in the study group and 19 male and 13 female infants in the control group. In the study group, the mean gestational age was 31.4 (±2.8) weeks with a range of 28-37 weeks, the mean for post-conceptual age at the time of beginning the intervention was 32.4 (±2.4) weeks with a range of

28-35.8 weeks, the mean length of hospitalization was 7.1 (±4.2) days with a range of 1-42 days, the mean of APGAR score was 7.4 (±0.7) with a range of 7-9 at the first minute and was 8.5 (±0.8) with a range of 7-10 at the fifth minute. Mean birth weight was 1529 (±503.9) g with a range of 750-2520 g.

In the control group, the mean for gestational age was 31.8 (±2.6) with a range of 28.8-37 weeks, the mean post-conceptual age was 32.5 (±2.3) weeks with a range of 28.6-36.3 weeks, the mean length of hospitalization was 5.03 (±3.5) days with a range of 1-26 days, the mean of APGAR score was 7.5 (±0.8) with a range of 7-10 at the first minute and was 8.6 (±0.9) with a range of 7-10 at the fifth minute.

The mean birth weight was 1669.3 (533.3) g with a range of 930-3110 g. The Chi-square test showed no significant difference in demographic characteristics between the two groups.

Mean and standard deviation of infants' physiologic responses are shown in Table 1. Comparison of physiologic responses between the two groups at various time points is shown in Table 2.

With regard to SPO_2[1], analysis of covariance showed significant difference in arterial O_2 saturation between the two groups in the morning hours ($P < 0.001$) and also afternoon hours ($P = 0.02$) during the intervention. Meanwhile, the difference was not significant before, immediately after, and 1 h after the intervention in the two groups [Table 2].

[1]oxygen saturation

Repeated measure ANOVA and *post-hoc* least significant difference (LSD) tests showed a significant increase in the means of arterial O_2 saturation during the intervention compared to before the intervention not only in the morning but also in the afternoon time points ($P = 0.003$), while it showed significant decrease in the control group ($P = 0.000$) [Tables 1 and 4].

With regard to respiration rate, Analysis of covariance showed a significant difference in the respiration rate during the intervention between the two groups not only in the morning ($P = 0.002$) but also in the afternoon ($P = 0.01$), but this difference was not significant at other time points [Table 2]. Repeated measure ANOVA and *post-hoc* LSD tests showed significant decrease in respiration rate in the study group during the intervention compared to before the intervention ($P = 0.001$) and during the intervention compared to 1 h after the intervention ($P = 0.000$) in the morning, while there was no difference at various time points in the morning ($P = 0.3$) and afternoon ($P = 0.7$) in the control group [Tables 1 and 4].

Analysis of covariance showed significant difference in the mean of heart rates only in the morning during the intervention between the two groups [Table 2] ($P = 0.006$).

Repeated measure ANOVA showed significant reduction in the mean heart rate in the study group at various time points in the morning ($P = 0.01$) compared to before the intervention. Although this reduction was significant just during the intervention, no change was observed in the afternoon. In the control group, heart rate had no significant difference at various time points in the morning but showed

Table 1: Mean and SD of physiologic responses at various time points in the two groups in the morning and afternoon

Time	Earmuff group						Control group					
	SPO_2		RR		PR		SPO_2		RR		PR	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Morning												
BI	93.6	3.7	53.7	17.6	139.7	17	93.4	2.1	51.6	16.7	138.2	15.5
DI	95.2	2.4	47.1	13.4	132.2	12.3	92.2	2.2	55	14.9	141	13.6
IAI	94.1	3.9	52.6	18.3	136.1	14.4	90.2	3.1	52.3	15.8	139.7	17.8
OHAI	92.6	4.4	55.7	16.2	137.6	15.8	91.3	3.3	56.1	17.3	143	18.9
P	0.001		0.000		0.01		<0.000		0.01		0.2	
Afternoon												
BI	93.3	3.8	58.4	17.5	141.6	14.1	93.6	2.9	50.2	16.8	143.3	17.3
DI	94.7	2.5	49.3	13	139	13.1	91.7	2.5	54.1	15.7	150	15.6
IAI	93.9	3	49.9	13.4	142.2	16.2	91.3	3.4	55.5	18.2	156	19.8
OHAI	94	3.2	54.8	15.4	140.5	17.2	91.3	3.6	55.8	19.3	157.6	19.1
P	0.01		0.000		0.1		<0.000		0.001		<0.000	

SPO_2: Oxygen saturation, RR: Respiratory rate, PR: Pulse rate, BI: Before intervention, DI: During intervention, IAI: Immediately after intervention, OHAI: 1 h intervention, *P*: *P* value, M: Mean, SD: Standard deviation significant increase at various time points compared to before the study in the afternoon [Tables 1 and 4].

Mean numbers of motor responses at various time points in the two groups have been presented in Table 3 and Figure 1. Results revealed significant reduction in the number of motor responses during the intervention in the morning ($P < 0.000$) and also during the intervention in the afternoon ($P < 0.001$), and immediately after the intervention ($P = 0.05$) in the study group compared to the control group.

Repeated measure ANOVA and *post-hoc* LSD tests showed a significant reduction in the number of motor responses in the study group in the morning ($P = 0.02$) and also in the afternoon ($P = 0.000$) [Table 3]. This reduction was during, immediately after, and 1 h after the intervention compared to before, during, immediately after, and 1 h after the intervention. In the control group, the number of responses significantly increased ($P = 0.000$) in the morning but showed no significant change in the afternoon ($P = 0.4$) [Table 4].

Table 2: Comparison of physiologic responses between the two groups at various time points in the morning and afternoon

Time	SPO_2	RR	PR
Morning			
P[2]/BI	0.1	0.3	0.1
P/DI	0.001>	0.002	0.006
P/IAI	0.6	0.8	0.9
P/OHAI	0.2	0.4	0.4
Afternoon			
P/BI	0.8	0.1	0.8
P/DI	0.02	0.01	0.1
P/IAI	0.08	0.02	0.5
P/OHAI	0.2	0.1	0.6

SPO_2: Oxygen saturation, RR: Respiratory rate, PR: Pulse rate, BI: Before intervention, DI: During intervention, IAI: Immediately after intervention, OHAI: 1 h intervention, [2]*P*: *P* value

Table 3: Mean and SD of motor response frequency at various time points in the two groups in the morning and afternoon

Motor responses	Earmuff group		Control group		*P*
	M	SD	M	SD	
Morning					
BI	33	19.3	33.5	16.6	0.6
DI	11.1	6.2	37	13.2	0.000>
IAI	17.5	17.1	36.7	15	0.07
OHAI	22.4	12.5	33.7	12.5	0.3
P	0.02		0.000		
Afternoon					
BI	29.3	18.6	25	10.8	0.6
DI	9.8	7.4	25	10.8	0.001>
IAI	17.6	3.6	22.8	15.8	0.05
OHAI	19.9	15.7	23.3	13.3	0.3
P	0.000		0.4		

BI: Before intervention, DI: During intervention, IAI: Immediately after intervention, OHAI: 1 h intervention, *P*: *P* value, M: Mean, SD: Standard deviation

With regard to the attitude of NICU nurses about the use of earmuffs, the results showed that 68% of nurses took care of infants with earmuff in some of the working shifts while 32% took care of them in most of the shifts. All the staff (100%) believed that use of earmuffs just interfered with the administration of routine nursing care sometimes, and is not hazardous for infants. About 44% of the nurses believed they were able to maintain the earmuffs in their appropriate location (infants' external ears) for a duration of 24 h, 72% believed the noise is often too loud in the NICU, and 64% believed wearing earmuffs is useful for infants.

With regard to pollution around the infant, the results showed that mean of sound intensity was at least 65.4 dB and at the most 89.8 dB. Mean of sound intensity in the morning hours and afternoon hours were 75.9 and 73.2 dB, respectively.

Discussion

With regard to Mean of oxygen saturation, the results showed an increase in oxygen saturation in the study group during the intervention compared to before that, while in the control group, there was a significant reduction in atrial O_2 saturation in the morning at time points similar to the study group, but there was no significant difference in the afternoon at various time points. As administration of invasive procedures for the infants can lead to a reduction of O_2 saturation level and these procedures were conducted for the subjects in both the groups, all the subjects in the groups were observed concerning dependant variables at similar time points.

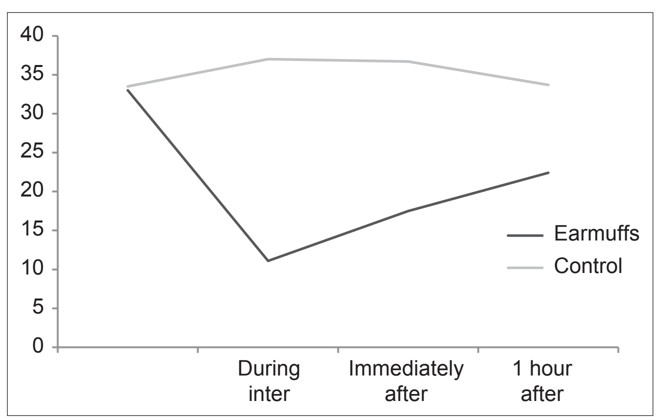

Figure 1: Changes in mean numbers of motor responses in the two groups at various time points

Table 4: Pair wise comparison of physiologic and motor responses in the two groups at various time points in the morning and afternoon

Time	Physiologic/motor responses (group)							
	Earmuff				Control			
	SPO_2	RR	PR	MR	SPO_2	RR	PR	MR
Morning								
BWD	0.003	0.001	0.009	0.000	0.000	0.02	0.02	0.06
BWIA	0.4	0.6	0.1	0.001	0.000	0.6	0.6	0.3
BWOHA	0.2	0.3	0.6	0.006	0.000	0.01	0.01	0.7
DWIA	0.02	0.01	0.04	0.02	0.01	0.1	0.1	0.09
DWOHA	0.001	0.000	0.04	0.000	0.03	0.5	0.5	0.01
IAWOHA	0.02	0.03	0.4	0.01	0.5	0.01	0.01	0.1
Afternoon								
BWD	0.003	<0.000	0.09	0.000	0.000	0.001	0.001	0.05
BWIA	0.3	<0.000	0.8	0.001	0.000	0.000	0.000	0.1
BWOHA	0.1	0.1	0.6	0.004	0.000	0.000	0.000	0.001
DWIA	0.07	0.6	0.1	0.000	0.2	0.1	0.000	0.000
DWOHA	0.1	0.003	0.4	0.000	0.1	0.4	0.000	0.000
IAWOHA	0.6	0.002	0.3	0.1	0.5	0.3	0.1	0.03

MR: Motor responses, BWD: Before with during, BWIA: Before with immediately after, BWOHA: Before with 1 h after, DWIA: During with immediately after, DWOHA: During with 1 h after, IAWOHA: Immediately after with 1 h after

The researcher tried to have subjects' randomization. So, one of the possible causes for the reduction in O_2 saturation in subjects in the control group can be the gradual increase in the level of noise pollution in the related NICU at 9:00-11:00 AM. In other words, at 8:45 AM at which assessment of the variables started, environmental noise had a lower intensity compared to 10:00 AM when physicians' rounds and nursing cares started.

Zahr and Traversay in their study showed that use of earmuffs in low birth weight infants increased their O_2 saturation level.[14] Johnson in a study on premature infants (26-32 weeks) decreased the sound received by them by 3.27 dB through the use of acoustic foam in their incubator and showed an increase in their O_2 saturation level.[15] In the present study, we used earmuffs to decrease the sound intensity by at least 7 dB and the sound pressure by 50% (local pressure deviation from the ambient atmospheric pressure caused by a sound wave) and obtained similar results as those of the two above-mentioned studies. In addition, in these two studies, the effect of intervention was assessed just during the intervention, while in the present study, we also investigated its longer effect immediately after and 1 h after the intervention. With regard to lack of stability and persistency of changes in arterial O_2 saturation as a result of intervention in the present study, the importance of constant and long-term reduction of noise pollution is highlighted.

With regard to mean respiration rate, the results showed a reduction in premature infants' respiration rate during wearing earmuffs in the study group, but immediately after removing the earmuffs, their rate of respiration increased, so that 1 h after the intervention, it almost reached its before intervention rate. These results are consistent with those of previous studies. For instance, Zahr and Balian in their study on premature infants (23-37 weeks of gestational age) concluded that exposure of infants to the routine noise of NICU such as that caused by device alarms, phone rings, and the noise of nursing care procedures increased their respiration rate and decreased their arterial O_2 saturation.[16] Ward and Davis exposed 42 infants of whom 20 were premature with gestational age <32 weeks to noises with sound intensity of 80, 90, and 100 dB and observed increased heart rate in all infants, especially the premature ones.[17] In the present study, contrary to the above study, we reduced the received noise through the use of earmuffs. Although the use of earmuffs reduced infants' heart rate, the effects of intervention did not last immediately after and 1 h after the removal of earmuffs. The results obtained by us are in line with the results of Wharrad and Davis.

Taheri *et al*. conducted a silence program in the NICU and reported that infants' heart and respiration rates showed no significant differences compared to before the intervention.[12] Meanwhile, in the present study, heart rate showed a significant decrease during the intervention compared to before the intervention. It should be noted that the level of decreased sound intensity in Taheri's study has not been mentioned to let one compare the degree of changes in physiologic parameters in relation with an intensity of noise pollution, and evaluate the level of success of silence program to lower noise. Conducting silence intervention during 1:00-3:00 PM, which is the quietest time in the ward, can be another reason for lack of change in infants' heart rate during an intervention in the above study.

With regard to the number of motor responses, as observed in Figure 1, motor responses showed a reduction during the intervention, immediately after, and 1 h after the intervention compared to before the intervention. Zahr and Traversay showed that use of earmuffs led to more relaxation and lower number of behavioral responses in hospitalized infants. In the present study, we investigated the motor responses of twitch, tremor, and startle movements and obtained results similar to those of Zahr.

Duran *et al*. used earmuffs for premature infants with weight <1500 g, undergoing critical care in an incubator and observed a notable difference in their behavioral responses. In other words, the infants scored higher in

Anderson Behaviour Scoring Scale through wearing earmuffs and fell asleep for more time.[13,18]

In the present study, earmuffs were used to diminish infants' exposure to noise pollution; poll results from NICU nurses showed that they believed the use of earmuffs is beneficial for infants and agreed to use earmuffs routinely in future for carrying infants in the NICU. This finding coincides with that of Abou Turk *et al*.

Based on American Academy of Pediatrics, the safe level of noise in the NICUs is 30 dB during nights and 45 dB during daytime. In the present study the recorded values of sound level during daytime in the NICU were minimum 65.4 dB and maximum 89.8 dB, which are far from the safe levels of sound in the NICUs.

The restrictions in the presented study were low number of subjects and the lack of infants' follow-up for a long duration after earmuffs' use.

Conclusion

In the present study the noise exposure in preterm infants were reduced by wearing ear muff, and the results showed improvement in physiologic and motor responses in the subjects. So it is suggested to protect infants from complications of noise pollution in NICUs by routine using earmuff.

Acknowledgments

This study was financially sponsored by Isfahan University of Medical sciences. We would like to thank the head of shahid Beheshti hospital, Clinical Research Development Center and authority of NICU ward of shahid Beheshti hospital, as well as participants' parents.

References

1. Mandy GT, Weisman LE, Kim MS . Incidence and mortality of the premature infant. www.uptodate.com/contents/ Incidence and mortality of the premature infant.2008.
2. Ebrahimi S, Haghbin S, Poormahmoodi A. Incidence and Eiologic facor of premauriy'.SID 2000-2001;32:35-9.
3. Kellam B, Bhatia J. Sound spectral analysis in the intensive care nursery: Measuring high-frequency sound. J Pediatr Nurs 2008;23:317-23.
4. Gooding LF. Using music therapy protocols in the treatment of premature infants: An introduction to current practices. Art Psychother 2010;37:211-4.
5. Perlman JM. Neurobehavioral deficits in premature graduates of intensive care-potential medical and neonatal environment risk factors. Pediatrics 2001;108:1339-48.
6. Blackburn S. Environmental impact of the NICU on developmental outcome. J Pediatr Nurs 1998;13:279-89.
7. Martin RJ, Fanaroff AA, Walsh MC. Fanaroff and Martin's neonatal-perinatal medicine: Diseases of the fetus and infant. 9th ed. Missouri: Elsevier Mosby; 2011. p. 261-1072.
8. Blackburn ST. Neurologic, muscular and sensory systems. In: Gower LK, editor. Maternal, fetal, and neonatal physiology: A clinical perspective. 3th ed. Philadelphia: WB Sunders; 2007. p. 542-8.
9. White-Traut RC, Nelson MN, Silvester MJ, Patel M, Lee H, Cimo S, *et al*. Maturation of the cardiac response to sound in high-risk preterm infants. Newborn Infant Nurs Rev 2009;9:193-9.
10. Mann NP, Haddow R, Stokes L, Goodley S, Rutter N. Effect of night and day on preterm infants in a newborn nursery: Randomised trial. Br Med J 1986;293:1265-7.
11. Wachman EM, Lahav A. The effects of noise on preterm infants in the NICU. Arch Dis Child Fetal Neonatal Ed 2011;4:305-9.
12. Taheri P, Abbasi E, Abdeyazdan Z, Fathizadeh N. The effects of a designed program on oxygen saturation and heart rate of premature infants hospitalized in neonatal intensive care unit of Al-Zahra hospital in Isfahan in 2008-2009. Iran J Nurs Midwifery Res 2010;15:66-70.
13. Abou Turk C, Williams AL, Lasky RE. A Randomize clinical trial evaluating silicone earplugs for very low birth weight newborns in intensive care. J Prenatol 2009;29:358-63.
14. Zahr LK, de Traversay J. Premature Infant Responses to Noise Reduction by Earmuffs: Effects on Behavioral and Physiology Measures. J Perinatol 1995;15:448-55.
15. Johnson AN. Neonatal response to control of noise inside the incubatore. Pediatr Nurs 2001;27:600-5.
16. Zahr Lk, Balian S. Responses of premature infants to routine nursing interventions and noise in the NICU. Nurs Res 1995;44:179-85.
17. Whrrad HJ, Davis AC. Behavioural and autonomic responses to sound in preterm and full-term babies. Br J Audiol 1997;31:315-29.
18. Duran R, Ciftdemir NA, Ozbek UV, Berberoglu U, Durankus F, Sut N, *et al*. The effects of noise reduction by earmuffs on the physiologic and behavioural responses in very low birth weight preterm infants. Int J Pediatr Otorhinplaryngol 2012;76:1490-3.

How to site: Abdeyazdan Z, Ghassemi S, Marofi M. The effects of earmuff on physiologic and motor responses in premature infants admitted in neonatal intensive care unit. Iranian Journal of Nursing and Midwifery Research 2014;19:107-12.

Source of Support: Nil, **Conflict of Interest:** Nil.