Relaxation Therapy on Fetal Outcomes in Complicated Pregnancies Suffering Sleep Disorders: A Randomized Clinical Trial

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Abstract

Background: Sleep disorders like snoring, mouth breathing, and insomnia are frequent in pregnancy and studies have shown that poor sleep is linked to obstetric complications. Muscle relaxation technique is an effective method used for improving sleep quality. The purpose of this study was to determine the effect of muscle relaxation technique on fetal outcomes in complicated pregnancies with sleep disorders.

Methods: This study was performed as a clinical trial on 160 pregnant women who suffered from preeclampsia and gestational diabetes. The participants filled the Pittsburgh Sleep Quality Index (PSQI) in order to measure the quality and patterns of their sleep. The participants with the total score of 5 or more were included in the present study. Intervention group were asked to use muscle relaxation technique twice a week at home for 8 weeks alongside the routine care. Study variables included sleep quality, Apgar scores, birth weight, levels of Interleukin- 6 (IL-6), as well as umbilical cord PH and PO2.

Results: The mean score of PSQI before the intervention was 9.28 ± 4.16 and 9.18 ± 3.06 in the intervention and control groups without a significant difference (P=0.6), respectively. However, PSQI global score of the experimental group was smaller than the control group at the end of the study (P<0.001). Also, birth weight (P=0.04), Apgar score (P=0.01), and umbilical cord blood po2 (P=0.03) and PH (P=0.01) were higher, and IL-6 (P=0.04) was smaller in the experimental group compared to the control group.

Conclusion: The results of this study showed that muscle relaxation, as a simple, inexpensive and safe method, can improve the fetal outcomes such as birth weight, Apgar score, cord blood po2, and cord blood PH, and also it leads to lower IL-6 in complicated pregnancies.

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Introduction

The hormonal changes and physical discomfort associated with pregnancy can affect a pregnant woman's sleep pattern. Frequent nighttime voiding of urine, leg cramps, sinus congestion, anxiety, and discomfort due to the growing uterus can lead to sleep disturbances.[1] Furthermore, Estrogen induces hyperemia, nasopharyngeal mucosal edema, and vasomotor rhinitis, which can lead to the narrowing of the upper

airway; also it may increase the risk of sleep-disordered breathing (SDB) among pregnant women. Snoring is one of the common symptoms of SDB.[2] In Saberge's study, the frequency of snoring had been approximately 7.9% in the first trimester and increased to 21.2% in the third trimester. Heavier snoring pregnant women were weightier than non-snoring pregnant women.[3] In a study conducted in China, 56.1% of pregnant women declared sleep disorders like snoring, mouth breathing, and insomnia.[4] As a result of snoring, insomnia and frequent awakenings during pregnancy daytime sleepiness and fatigue may occur.[5]

Recent studies showed that poor sleep is linked to obstetric complications such as pregnancy induced hypertensions, preterm birth, gestational diabetes and also sleep disturbances is associated with prolonged labor, more pain in labor, and cesarean delivery.[6-9] There is conflicting information about the impact of sleep disorders on the fetal outcomes. Some studies have shown a connection between sleep disorders and Apgar score, birth weight and prematurity.[10] Previous studies have stated that sleep disorders can alter the immune response; the most significant effect is the increase in inflammatory cytokines such as Interlukins-1, 2, and 6 and Tumor Necrotizing Factor (TNFα)[11] (Okun et al.'s study showed that sleep deprivation in the middle and late pregnancy stage is associated with increased risk of preterm delivery and raising inflammatory cytokines. This plays a key role in labor process by increasing the production of uterine tissue prostaglandins, cervix softening that leads to preterm uterine contractions.[7,12] In most studies, a correlation has been reported between maternal stress and preterm labor followed by low birth weight and low Apgar score. Muscle relaxing technique is an effective method in preventing preterm labor. Applying this therapy can lead to a decrease in maternal stress, increased birth weight, and newborn's Apgar scores at 1 and 5 minutes.[13] Also, it can reduce pregnancy complications such as severity of gestational diabetes and preeclampsia in high risk pregnant women.[14] Another semi-experimental *study* showed the impact of muscle relaxation techniques on the mother's health index and satisfaction besides increasing infant Apgar score.[15] Muscle relaxation techniques have had a positive impact on variation of heart rate and systolic blood pressure, lung function, and quality of life.[16,17] These techniques are safe and cost effective and other studies have indicated that applying these techniques can result in reduction of anxiety, insomnia, headaches, high blood cholesterol, high blood pressure, labor pain, and premenstrual syndrome.[18-20]

Gestational diabetes is a common complication that mostly occurs after 24 weeks of gestation. Gestational diabetes occurs when a women without previous diabetes develops high blood sugar levels during pregnancy. Class A_1 of gestational diabetes is defined by abnormal glucose tolerance test with normal fasting blood sugar. Class A_2 of gestational diabetes is diagnosed when glucose tolerance test is abnormal in addition to abnormal fasting blood sugar, which requires additional therapy with insulin or other medications.[21] Pre-eclampsia is a disorder of pregnancy characterized by high blood pressure and proteinuria. A systolic blood pressure greater than or equal to 160 mm Hg or a diastolic blood pressure greater than or equal to 110 mm Hg and severe proteinuria are common singe of severe preeclampsia. Both of the two pregnancy complications result in adverse effects on maternal and fetal outcomes.[22]

Respiratory disorder is prevalent among pregnant women while sleeping. Despite recent studies on the effect of muscle relaxation technique on fetal outcomes in low risk pregnancy, there is no evidence of relaxation technique's impact on fetal outcomes in high-risk pregnancy with sleep disorders. Therefore, conducting a research in this regard on high risk pregnant women seemed to be necessary.

The purpose of this study was to determine the effect of muscle relaxation exercise on fetal outcomes in complicated pregnancy with preeclampsia and gestational diabetes with sleep disorders.

Patients and Methods

Research environment and participants: This study was performed as a clinical trial on pregnant women in Hafez hospital, a tertiary hospital, affiliated to Shiraz University of Medical Sciences. Sampling lasted from Marchto late September 2013. This study was approved by the Ethics Committee of Shiraz University of Medical Sciences and received ethics code number CT-92-6814. Also, the present study was recorded in the Iranian Registry of Clinical Trials with number IRCT2013092310327N5.

Inclusion criteria of the study were as follows: Single alive and healthy fetus with vertex presentation, gestational age of 26-28 weeks, aged 19-35 years, non-smoker, nonblack of addiction to any substance, and non-alcoholic consumption. In the present study, only high risk pregnant women such as gestational diabetes, class A_2, and mild preeclampsia could participate in our study. According to textbooks, class A_2 of gestational diabetes is defined as insulin-treated women with fasting glucose level>105 mg/dL or 2 hours postprandial glucose level>120 mg/dL. Also, mild preeclampsia is defined as hypertension (140≥systolic pressure<160 mm Hg and 90≥diastolic pressure<110 mm Hg) accompanied with 1+dipstick protein in random urine sample after the 20th week of gestation.[23] If the mother had performed the relaxation technique less than twice a week, she was excluded

from the study. Initially, written informed consent forms were obtained from those who met the inclusion criteria. Then, the participants filled the Pittsburgh Sleep Quality Index (PSQI) in order to measure the quality and patterns of their sleep. PSQI consists of seven domains: subjective sleep quality, sleep latency, sleeps duration, habitual sleep efficiency, and sleep disturbances, use of sleeping medication, and daytime dysfunction over the last month. The total score ranges from 0-21. A global sum of "5" or greater which indicated a "poor" sleeper was required for entering the present study. In Backhanus et al.'s study, thecorrelation coefficient for test–retest reliability was 0.87. A PSQI global score>5 resulted in a sensitivity of 98.7 and specificity of 84.4, as a marker for sleep disturbances in insomnia patients versus the controls.[24] Also, Iranian studies showed the high reliability and validity of PSQI.[25,26]

Intervention method: Muscle relaxation technique was instructed to the participants in the intervention group at the hospital in two sessions individually. Then, the subjects were asked to exercises twice a week at home for 8 weeks alongside the routine care. The researcher called the participants to emphasize the importance of regular exercises. After eight weeks, PSQI was used to assess the sleep quality; then, the pre- and post-intervention results were collected.

Muscle relaxation technique: After finding a quiet and comfortable place to sit or lie down, the relaxation was started from the toes and feet. First, the mother tensed the muscle groups and then released the tension. It was extended to the abdominal, chest and neck muscles, and finally ended at the head and facial muscles. Concentration on inhaling exhaling deeply and holding their breath for 2 seconds were parts of this relaxation. Duration of muscle relaxation was ten minutes per session at the beginning and was extended to 20 minutes later on. On the contrary, the women in the control group just received routine pregnancy care and filled PSQI at the onset of the study and eight weeks later.

Variables: Study variables included demographic characteristics, sleep quality, Apgar scores, birth weight, levels of Interleukin- 6 (IL-6), as well as umbilical cord PH and PO2.

Measuring IL-6: After collecting Umbilical Cord blood (about 5 ml), blood serum separation was performed and it was stored at -80 ° C until testing time. The IL-6 level was measured by ELISA method.

Measurement of pH, and pO$_2$ of umbilical cord: Immediately after expulsion of the placenta, 1 ml of the arterial blood of umbilical cord was drawn into an insulin syringe which was previously treated with heparin 1000 units per milliliter, and within a maximum

of 60 minutes after delivery, pH, and pO$_2$ were measured by Gazometeric device, Opticca-TS model.

Sample size and statistical analysis: We could not find a similar study to use its means for determining the sample size. The statistics analyst recommended 80 candidates to be selected for each group. Selected samples were allocated by block randomization into two experimental and control groups. Data were stored and analyzed using SPSS, version18. Quantitative variables were compared between the two groups, using independent two samples T- test. Chi-square test was used for categorical variables. Besides, $P<0.05$ were considered as statistically significant.

One of the research team members was responsible for participant selection, randomization, and teaching the relaxation. The data were collected by trained midwives outside the research team who were blind to group allocations.

Results

Of 167 participants enrolled in this study, 7 were excluded due to severe preeclampsia (3), pre-term labor (2), and withdrawal during the study (2) (Figure 1). The mean age of the subjects in the experimental and control groups was respectively 28.91±4.63 and 27.18±3.67. Independent t-test showed that the mean age of the experimental group was higher compared to the control group (P=0.01). The education level in most participants of both groups was high school diploma and the majority were multiparous mothers (61.25%, n=98). Detailed demographic data is shown in Table 1. There was no significant mean difference of PSQI global scores between the two groups before the intervention by Independent t-test while PSQI global score of the experimental group was smaller than the control group at the end of the study (P<0.001). Also, birth weight (P=0.04), Apgar score (P=0.01), umbilical cord blood po2 (P=0.03), and PH (P=0.01) were higher; also, IL-6 (P=0.04) was smaller in the experimental group compared to the control group.

Discussion

Pre-eclampsia and gestational diabetes are the two common complications in pregnancy that can lead to weak maternal and fetal consequences.[21,22]

Ahmadpour et al.'s study showed that the newborns of high risk pregnant women had lower mean umbilical cord blood PH and Apgar scores at 1 and 5 minutes, and longer hospitalization in neonatal intensive care unit in comparison to low risk group. In addition, there was a high correlation between 1 and 5 minute Apgar scores and umbilical cord blood PH in the high risk group.[27] On the other hand, studies have shown that muscle relaxation can lead to improved maternal and fetal outcomes.[28] This study aimed to evaluate the
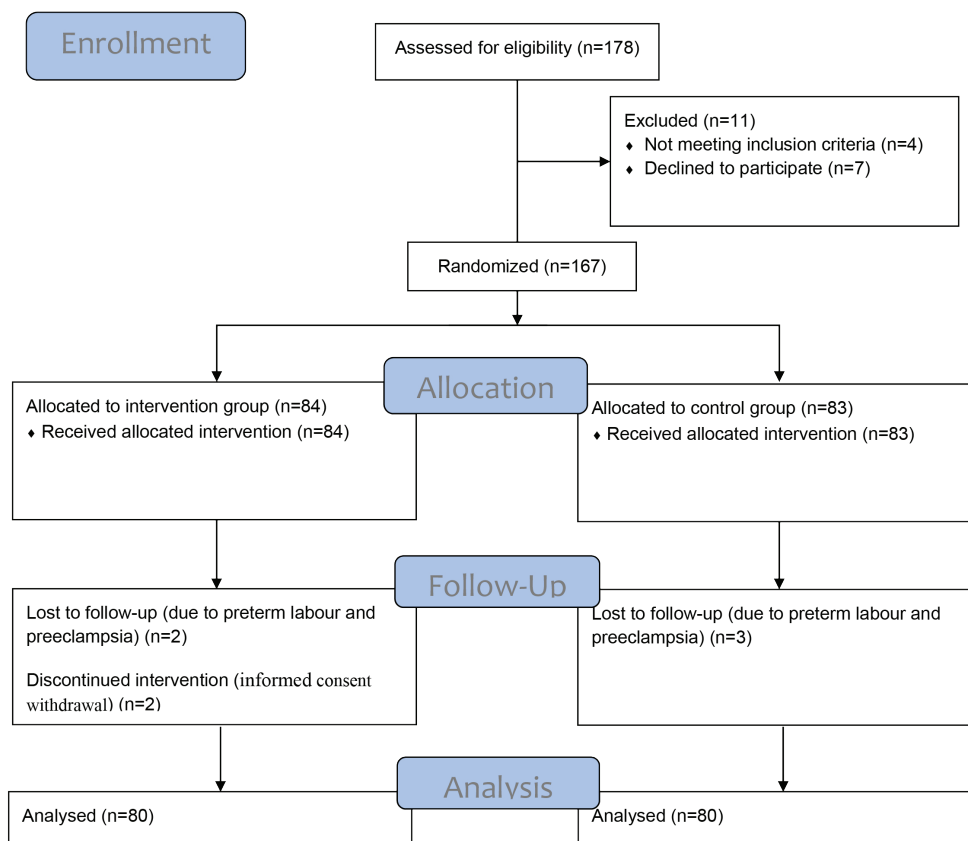
Figure 1: Sampling flow

Table 1: Demographic characteristics in the intervention and control groups

Variables		Groups		P value
		Intervention (n=80)	Control (n=80)	
Age (year) Mean (SD)		28.91 (4.63)	27.18 (3.67)	0.01
Education level N (%)	Primary school	17 (21.30)	14 (17.50)	0.10
	High school diploma	59 (73.80)	61 (76.30)	
	Graduate	4 (5.00)	5 (6.30)	
Job N (%)	Housewife	69 (86.25)	55 (68.75)	0.01
	Occupied	11 (13.75)	25 (31.25)	
Referring Reasons N (%)	Gestational diabetes	40 (50.00)	37 (46.25)	0.45
	Preeclampsia	320(40.00)	340(42.5)	
	Both	8 (10.00)	9 (11.25)	
Parity N (%)	Nuliparity	27 (33.75)	35 (43.8)	0.06
	Others	53 (66.25)	45 (56.25)	

effect of relaxation techniques on fetal outcomes in pregnant women with preeclampsia and gestational diabetes who suffered from sleep disorders. According to the results of our study, muscle relaxation exercises can lead to improved fetal outcomes, such as Apgar score at 1 and 5 minutes, birth weight, umbilical cord blood PO2 and PH, and decreased level of cytokine IL-6 and sleep disorders in pregnancy.

Even though most studies have assessed relaxation

technique in low risk pregnant women, Rakhshani et al. applied yoga in women with a history of high risk pregnancy, such as preeclampsia, eclampsia, gestational diabetes, preterm labor, and low birth weight from 12 weeks gestation for 3 times a week. The results showed that yoga can reduce the incidence rate in pregnancy complications mentioned above and improves the fetal and neonatal outcomes.[15]

In Gad - Dal and Forse's study, the relaxation

techniques were thought and they were given guided imagery CD in the third trimester. Results showed lower stress level in mothers and better neonate Apgar scores in the relaxation group in comparison to the control group.[29] In another study, applying relaxation techniques in women at risk of preterm delivery indicated lower preterm delivery occurrence and hospitalization compared to the control group. But there was no significant difference between the two groups in the overall rate of preterm delivery, low birth weight, infant mortality rate, and Apgar score at 1 and 5 minutes.[14]

In our study, the mean umbilical cord blood Po_2 and PH were higher in the relaxation technique group than the control group. The relationship between the umbilical cord blood pH and its serious adverse neonatal outcomes was assessed in other studies which revealed an increased risk of adverse neurological outcome with PH lower 7 compared with higher PH.[30,31]

In the present study, the relaxation technique reduced the level of umbilical cord blood IL-6. Okun's study showed that inflammatory cytokine levels were higher in pregnant women with sleep disorder.[12] In Amarillo et al.'s study, the infants small for gestational age had higher levels of IL-6 in the umbilical cord blood compared to those with appropriate for gestational age.[32]

Maternal immune system, implantation site and fetal brain are the three main locations where the cells do respond to IL-6. IL-6 affects the fetal brain directly and plays an important role in learning and memory processes. This cytokine has a role in inflammation that can lead to impaired memory.[33]

In the present study, relaxation technique led to reduction in sleep disorders in pregnant women with gestational diabetes and pre-eclampsia. In a study on patients with chronic hepatitis using muscle relaxation, the sleep quality improved compared to the control group.[34] Another study showed muscle relaxation could provide better sleep quality in multiple sclerosis patients.[35] A systematic review study showed that muscle relaxation can reduce sleep disorders up to 38 percent.[36]

Conclusion

The results of this study showed that muscle relaxation, as a simple, inexpensive and safe method, can lead to improved quality of sleep in pregnant women with gestational diabetes and pre-eclampsia. Thus, the mother's improved sleep quality can lead to better fetal and neonatal outcomes including Apgar scores, birth weight, umbilical cord blood PO_2 and PH as well as a decrease in IL-6 level. Therefore, we recommend training of muscle relaxation in prenatal visits to pregnant mothers for developing fetal outcomes.

As far as we know, this was the first study that evaluated the effects of muscle relaxation on sleep quality in pregnancies with some complications. The limitation of this study was that exercises were performed at home. The participants were only reminded to exercise through phone call, so the researcher's awareness of the quality and number of exercises was merely dependent on the participant's statements. Further studies with researchers having control over the number and quality of muscle relaxation exercise are recommended.

Acknowledgement

Conflict of Interest: None declared.

References

1. Facco FL, Kramer J, Ho KH, Zee PC, Grobman WA. Sleep disturbances in pregnancy. Obstetrics and gynecology. 2010;115(1):77-83. Epub 2009/12/23.

2. Venkata C, Venkateshiah SB. Sleep-disordered breathing during pregnancy. The Journal of the American Board of Family Medicine. 2009;22(2):158-68.

3. Sarberg M, Svanborg E, Wirehn AB, Josefsson A. Snoring during pregnancy and its relation to sleepiness and pregnancy outcome - a prospective study. BMC pregnancy and childbirth. 2014;14:15. Epub 2014/01/15.

4. Cai X-H, Xie Y-P, Li X-C, Qu W-L, Li T, Wang H-X, et al. The prevalence and associated risk factors of sleep disorder-related symptoms in pregnant women in China. Sleep Breath. 2013;17(3):951-6.

5. Erem C, Kuzu UB, Deger O, Can G. Prevalence of gestational diabetes mellitus and associated risk factors in Turkish women: the Trabzon GDM Study. Archives of Medical Science : AMS. 2015;11(4):724-35.

6. Facco FL, Liu CS, Cabello AA, Kick A, Grobman WA, Zee PC. Sleep-disordered breathing: a risk factor for adverse pregnancy outcomes? American journal of perinatology. 2012;29(4):277-82. Epub 2011/11/23.

7. Okun ML, Schetter CD, Glynn LM. Poor sleep quality is associated with preterm birth. Sleep. 2011;34(11):1493.

8. Izci B, Martin SE, Dundas KC, Liston WA, Calder AA, Douglas NJ. Sleep complaints: snoring and daytime sleepiness in pregnant and pre-eclamptic women. Sleep Medicine. 2005;6(2):163-9.

9   Herring SJ, Nelson DB, Pien GW, Homko C, Goetzl LM, Davey A, et al. Objectively measured sleep duration and hyperglycemia in pregnancy. Sleep Medicine. 2014;15(1):51-5.

10 Tauman R. Maternal Sleep and Fetal Outcome. Open Sleep Journal. 2013;6(1):63-7.

11 Mullington JM, Simpson NS, Meier-Ewert HK, Haack M. Sleep loss and inflammation. Best practice & research Clinical endocrinology & metabolism. 2010;24(5):775-84. Epub 2010/11/30.

12 Okun ML, Coussons-Read ME. Sleep disruption during pregnancy: how does it influence serum cytokines? Journal of reproductive immunology. 2007;73(2):158-65.

13 Rakhshani A, Nagarathna R, Mhaskar R, Mhaskar A, Thomas A, Gunasheela S. The effects of yoga in prevention of pregnancy complications in high-risk pregnancies: a randomized controlled trial. Preventive medicine. 2012;55(4):333-40. Epub 2012/08/14.

14 Chuang L-L, Lin L-C, Cheng P-J, Chen C-H, Wu S-C, Chang C-L. The effectiveness of a relaxation training program for women with preterm labour on pregnancy outcomes: A controlled clinical trial. International Journal of Nursing Studies. 2012;49(3):257-64.

15 Rakhshani A, Nagarathna R, Mhaskar R, Mhaskar A, Thomas A, Gunasheela S. The effects of yoga in prevention of pregnancy complications in high-risk pregnancies: A randomized controlled trial. Preventive Medicine. 2012;55(4):333-40.

16 Webb RC. Smooth muscle contraction and relaxation. Advances in physiology education. 2003;27(4):201-6.

17 Van Montfrans G, Karemaker J, Wieling W, Dunning A. Relaxation therapy and continuous ambulatory blood pressure in mild hypertension: a controlled study. BMJ. 1990;300(6736):1368-72.

18 Scheufele PM. Effects of progressive relaxation and classical music on measurements of attention, relaxation, and stress responses. Journal of behavioral medicine. 2000;23(2):207-28.

19 Smith JC, Joyce CA. Mozart versus new age music: Relaxation states, stress, and ABC relaxation theory. Journal of Music Therapy. 2004;41(3):215-24.

20 Nedstrand E, Wijma K, Wyon Y, Hammar M. Applied relaxation and oral estradiol treatment of vasomotor symptoms in postmenopausal women. Maturitas. 2005;51(2):154-62.

21 Mishra S, Rao CR, Shetty A. Trends in the Diagnosis of Gestational Diabetes Mellitus. Scientifica. 2016;5489015(10):12.

22 Mol BW, Roberts CT, Thangaratinam S, Magee LA, de Groot CJ, Hofmeyr GJ. Pre-eclampsia. Lancet. 2016;387(10022):999-1011.

23 Cunningham FG. Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BL et al. Williams obstetrics.2010; 23th. New York; the MaGraw- Hill companies.

24 Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test–retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. Journal of Psychosomatic Research. 2002;53(3):737-40.

25 Nazifi M, Mokarami H, Akbaritabar A, Kalte HO, Rahi A. Psychometric Properties of the Persian Translation of Pittsburgh Sleep Quality Index. Health Scope. 2014;3(2):e15547. Epub 2014-05-06.

26 Farrahi Moghaddam J, Nakhaee N, Sheibani V, Garrusi B, Amirkafi A. Reliability and validity of the Persian version of the Pittsburgh Sleep Quality Index (PSQI-P). Sleep Breath. 2012;16(1):79-82.

27 Ahmadpour-Kacho M, Asnafi N, Javadian M, Hajiahmadi M, Taleghani N. Correlation between Umbilical Cord pH and Apgar Score in High-Risk Pregnancy. Iran J Pediatr. 2010;20(4):401-6.

28 Fink NS, Urech C, Cavelti M, Alder J. Relaxation during pregnancy: what are the benefits for mother, fetus, and the newborn? A systematic review of the literature. J Perinat Neonatal Nurs. 2012;26(4):296-306.

29 Gedde-Dahl M, Fors EA. Impact of self-administered relaxation and guided imagery techniques during final trimester and birth. Complementary therapies in clinical practice. 2012;18(1):60-5.

30 Van Den Berg PP, Nelen WL, Jongsma HW, Nijland R, Kollée LA, Nijhuis JG, et al. Neonatal complications in newborns with an umbilical artery pH< 7.00. American Journal of obstetrics and gynecology. 1996;175(5):1152-7.

31 Phelan JP, Martin GI, Korst LM. Birth asphyxia and cerebral palsy. Clinics in perinatology61-76:(1)32;2005 ..

32 Amarilyo G, Oren A, Mimouni F, Ochshorn Y, Deutsch V, Mandel D. Increased cord serum inflammatory markers in small-for-gestational-age neonates. Journal of Perinatology. 2011;31(1):30-2.

33 Smith SE, Li J, Garbett K, Mirnics K, Patterson PH. Maternal immune activation alters fetal brain development through interleukin-6. The Journal of Neuroscience. 2007;27(40):10695-702.

34 Liu C, Xie H, Zhang X, Yu Y, Zhang X, Sun Y, et al. Health related management plans improve sleep disorders of patients with chronic liver disease. International journal of clinical and experimental medicine. 2015;8(6):9883.

35 Dayapoğlu N, Tan M. Evaluation of the effect of progressive relaxation exercises on fatigue and sleep quality in patients with multiple sclerosis. The Journal of Alternative and Complementary Medicine. 2012;18(10):983-7.

36 Tamrat R, Huynh-Le M-P, Goyal M. Non-pharmacologic interventions to improve the sleep of hospitalized patients: A systematic review. Journal of general internal medicine. 2014;29(5):788-95.