

The relationship between anxiety and sleep quality in Iranian pregnant women

Relación entre la ansiedad y la calidad del sueño en mujeres embarazadas iraníes

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Abstract

Objectives: Sleep disturbances are common in women, especially during pregnancy. Anxiety is a common disorder that can be accompanied by obstetric, neonatal and postnatal complications. This can result in emotional and psychological consequences in pregnant women. We aimed to evaluate the relationship between the anxiety and the sleep quality among pregnant women in Mashhad - Iran, in 2020.

Materials and methods: This cross-sectional study was conducted on 565 pregnant women who were referred to Mashhad health centers. Two-stage cluster sampling method was used to choose the patients. The data were collected using a socio-demographic questionnaire, state-trait anxiety inventory (STAI) and Pittsburgh Sleep Quality Index (PSQI). A general linear model was used in order to estimate the effect of independent variables (sleep quality and socio-demographic characteristics) on the dependent variable (anxiety).

Results: The mean \pm standard deviation (SD) sleep quality score was 3.6 ± 1.4 (range: 0-21), and the mean anxiety score was 4.7 ± 3.7 (range: 0-30). A significant correlation was found between anxiety score and total score of sleep quality and all its sub-domains except delay in sleeping. According to the adjusted general linear model, sleep quality, age, marital relationship, the satisfaction of husband job, place of residence and place of receiving prenatal care were predictors of anxiety.

Conclusion: Considering the significant relationship between anxiety and sleep quality in pregnant women, sleep hygiene education will be necessary in order to decrease the anxiety of pregnant women.

Keywords: Anxiety, pregnancy, sleep, Pittsburgh Sleep Quality Index, state-trait anxiety inventory.

Resumen

Objetivos: Los trastornos del sueño son frecuentes en las mujeres, especialmente durante el embarazo. La ansiedad es un trastorno común que puede acompañarse de complicaciones obstétricas, neonatales y postnatales, esto puede provocar consecuencias emocionales y psicológicas en las mujeres embarazadas. Nuestro objetivo es evaluar la relación entre la ansiedad y la calidad del sueño entre las mujeres embarazadas en Mashhad - Irán, en 2020.

Materiales y métodos: Este estudio transversal se llevó a cabo en 565 mujeres embarazadas que fueron remitidas a los centros de salud de Mashhad. Se utilizó el método de muestreo por conglomerados en dos etapas para elegir a las pacientes. Los datos se recogieron mediante un cuestionario sociodemográfico, el inventario de ansiedad estado-rasgo (STAI) y el índice de calidad del sueño de Pittsburgh (PSQI). Se utilizó un modelo lineal general para estimar el efecto de las variables independientes (calidad del sueño y características sociodemográficas) sobre la variable dependiente (ansiedad).

Resultados: La puntuación media \pm desviación estándar (DE) de la calidad del sueño fue de $3,6 \pm 1,4$ (rango: 0-21), y la puntuación media de la ansiedad fue de $4,7 \pm 3,7$ (rango: 0-30). Se encontró una correlación significativa entre la puntuación de ansiedad y la puntuación total de la calidad del sueño y todos sus subdominios, excepto el retraso en el sueño. Según el modelo lineal general ajustado, la calidad del sueño, la edad, la relación conyugal, la satisfacción del trabajo del marido, el lugar de residencia y el lugar donde se recibe la atención prenatal fueron predictores de la ansiedad.

Conclusiones: Teniendo en cuenta la relación significativa entre la ansiedad y la calidad del sueño en las mujeres embarazadas, la educación en higiene del sueño será necesaria para disminuir la ansiedad de las mujeres embarazadas.

Palabras clave: Ansiedad, embarazo, sueño, Índice de calidad del sueño de Pittsburgh, inventario de ansiedad estado-rasgo.

Introduction

Sleep is a systematic and organized behavior that is repeated on a regular basis. Sleep substantially contributes to revitalization of mental and physiological processes and is required for accepting new tasks¹. Common sleep disturbances consist of insomnia, frequent waking in the night, increasing sleepiness during the daytime, mood complaints and unusual feelings during sleep². About two-thirds of pregnant women complain of abnormal sleep patterns. Sleep disorders during pregnancy usually increase with every trimester. Furthermore, total sleep time and night sleep increase during the first trimester^{3,4}. Pregnant women suffer from sleep onset problems, frequent awakenings, reduced night sleep hours, and decreased sleep efficiency, which starts as early as week 12 of pregnancy to 2 months postpartum⁵.

Okun and colleagues indicated that 25% of pregnant women suffer from significant sleep disorders in the first gestational trimester, and it increases up to 15% in the third trimester. Meanwhile, sleep duration during pregnancy decreases progressively⁶. Guendelman et al. also reported that 26% of healthy nulliparous women who were interviewed between 6 and 20 weeks of pregnancy had a night sleep of < 7 hours^{7,8}.

Sleep quality refers to an individual's mental characteristics and sleep experience (e.g. feeling relaxed and satisfied after waking up). Various factors such as illness, pain, mental stresses etc. can affect the sleep quality and quantity⁹. In addition, diseases such as colic, iron deficiency anemia and allergies^{10,11}.

Pregnancy is a highly critical period for developing mental health problems, and anxiety disorders are common mental disorders during pregnancy with a prevalence rate of 1 to 26% in low- and middle-income countries¹². Any person may experience anxiety due to various stressors or environmental pressures¹³.

This serious psychological factor extremely affects mothers and fetuses during pregnancy¹⁴. Prenatal anxiety may also affect the fetus through specific mechanisms. First, hormones such as catecholamines are released due to maternal stress, and pass across the placenta which affects fetal brain development at 12-22 weeks of pregnancy.

These hormones also result in umbilical artery contraction which in turn reduces oxygen and nutrients supply to the fetus¹⁵. In addition, maternal anxiety leads to preterm birth, emotional problems, attention deficit hyperactivity disorder (ADHD) symptoms, growth retardation, crying and restlessness, and low mental development in infants^{16,17}. In a study, depression and anxiety disorders were shown to predict infant sleep disorder¹⁸, such that newborns with anxious mothers experience higher

restlessness rates¹⁹. In this regard, 874 mothers between 20 and 34 years of age and their infants participated in a cohort study, and researchers found that maternal psychological distress affects infants sleep quality²⁰.

Materials and methods

Study Design and Participants

This cross-sectional study was conducted on 565 pregnant women with pregnancy ages equal to 15 weeks or more (the second or third trimester of pregnancy) who visited health centers, based in Mashhad-Iran in 2020. The inclusion criteria consisted of Iranian nationality, being a Muslim, living in Mashhad, being willing to participate in the study, having a singleton pregnancy, living with the husband during the study, and having no employment at night shift. The exclusion criteria included having multiple pregnancies, pregnancy with fetal abnormalities, history of anxiety during the non-pregnancy period, intense family dispute with husband as asserted by the individual, having infertility history, the record of visiting a physician for mental problems, history of taking medicines or hospitalization, medical problems during pregnancy such as thyroid, hypertension and high-risk pregnancy, history of mental illness –especially anxiety– in first degree relatives, taking medicines for sleep disorders such as insomnia, oversleeping and frequent waking, facing with problems such as the death of relatives, severe accident, serious illness of family members, financial problems, losing one's and husband's jobs and/or the stress caused by changing residence within last six months.

Sampling

A 2-stage cluster sampling method was used. Sampling was conducted in the health centers and bases of Mashhad city. Among 45 centers and 20 bases in this city, one-third of the health centers and bases (10 centers and 5 bases) were selected randomly through: <https://www.random.org/>. Twenty-one centers were governmental and 8 centers were private. These centers are not referral ones. The number of pregnant women selected from each health center was proportional to the size of the women covered by each center. For sampling, first, the number of pregnant women covered by the selected health center was determined; Then, the names of eligible women were listed, and they were numbered. The final participants to be included in the study were randomly selected based on the quota of each center. The selected pregnant women were called and invited for the study. The participants were first assessed in terms of basic information and eligibility criteria. If they were eligible for being included in the study, comprehensive information was provided for them about the aims of the study and confidentiality. If they were willing to participate in the research, the informed consent form was filled out by participants and the data collection tool was completed via an interview with participants.

Data Collection Tool

Data collection tool included socio-demographic characteristics questionnaire, state-trait anxiety inventory (STAI) and Pittsburgh Sleep Quality Index (PSQI).

The PSQI measures an individual's attitude toward sleep quality during 4 weeks. It has 7 subscales including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication and daily daytime dysfunction. The score of each subscale is between 0 and 3. The sum of the scores of these seven components comprises the total score of the scale ranging from zero to 21. The lower score shows the better situation of sleep. A score higher than 5 indicates the unfavorable quality of sleep. The reliability of the scale was 0.83. Its validity was reported by scale's creators at the appropriate level with the sensitivity of 89.6% and specificity of 86.5% in patient participants compared with the control group²¹. The scale was also used in a study on pregnant women in Mashhad-Iran²².

Sample Size

Sample size was estimated 377 individuals with respect to the study of Baghi et al. and considering $d = 0.05$ about the mean score of sleep quality ($m = 10.5$, standard deviation [SD] = 2.5, and $\alpha = 0.05$). As it was a cluster sampling, final sample size was calculated 565 individuals with respect to the design effect of 1.5. Statistical analysis of the data was performed using SPSS version 21. Descriptive statistics including frequency and percentage, mean, median, percentile 25 to percentile 75 and SD were used for describing socio-demographic characteristics, sleep quality, and anxiety. Normality of the quantitative data was measured by skewness and kurtosis and they had normal distribution except components of sleep duration, habitual sleep efficiency and use of sleeping medication. Pearson correlation test was used for determining the relationship between anxiety and sleep quality and its components with normal distribution. The Spearman correlation was used for abnormal variables. Any variable was included in the general linear model (GLM) individually in an unadjusted form to determine the relationship between socio-demographic characteristics and the score of anxiety. Then the variables with P value lower than 0.05 based on unadjusted GLM were entered into the adjusted GLM. The P value lower than 0.05 was considered significant.

Results

In this study, 612 pregnant women were assessed according to eligibility criteria and 47 women were excluded because they were not eligible. Finally, 565 women participated in the study by filling out the questionnaires. Mean (SD) age of participants was 28.7 years (5.5) and body mass index was 25.2 (3.2) kg/m². One-third of participants (33.5%) had diploma education and majority

of them (98.0%) were housewives. Almost two-thirds of women (63.8%) reported that their monthly income is less than enough amount. Ninety-five percent of women received prenatal care from health centers and about two thirds of respondents (64%) were satisfied with their husband job. More than three-quarters of women (76.5%) reported that they were willing to pregnancy. Seventy-eight percent of women and 76% of their husbands were satisfied with fetal sex (**Table I**). The mean (SD) sleep quality score was 3.6 (1.4) from attainable score of 0-21 and mean (SD) anxiety score was 4.7 (3.7) from attainable score of 0-30. About 6% of women suffered from sleep disorders. Women had the highest mean score or the worst status in subscale of impaired daily dysfunction and the lowest mean score or the best status in the subscale of hypnotic drugs consumption. According to Pearson test, there was statistically significant correlation between anxiety score and total score of sleep quality ($P < 0.001$) and sub-domains of subjective sleep quality (0.016), sleep disturbance ($P < 0.001$) and daytime dysfunction ($P < 0.001$). According to Spearman test, there was statistically significant correlation between anxiety score and sub-domains of sleep duration ($P < 0.001$), and sleep hypnotic drugs ($P < 0.001$; **Table II**).

Discussion

Sleep disturbances are common in women, especially during pregnancy, and are associated with emotional and psychological consequences. In the State Anxiety Inventory, the highest prevalence of mild anxiety was in the first trimester, for moderate anxiety in the second trimester, and for severe anxiety in the third trimester. In the trait anxiety inventory, higher prevalence of moderate anxiety was in the first trimester, for mild and severe anxiety in the second trimester, and for moderate and relatively severe anxiety in the third semester. In a research raised by Signal et al., on 406 pregnant women using Edinburgh Postnatal Anxiety Scale, by the end of pregnancy, 22%, 25%, and 55% of the women experienced symptoms of depression, anxiety, and stress, respectively. Less than 55% of women reported depressed mood for more than 2 weeks, and factors such as the history of maternal depression and younger age were important predictors of depression, stress, and anxiety caused by a feeling of inefficiency. Maternal mental health should be considered equally important in pregnancy period and the postpartum period²³. Rallis et al. revealed that the rate of anxiety, and stress during pregnancy trimesters differ, increased anxiety and stress in the late pregnancy²⁴. Consistent with other studies, current findings underline the importance of mental problems incidence in early pregnancy and a history of it even before pregnancy on sleep quality of pregnant women. Accordingly, in the current study, moderate depression, mild anxiety, and moderate anxiety were reported in the first trimester. Severe anxiety had a higher incidence in the third trimester. Thus, to have a

good mental and physical health during pregnancy, the prevalence of psychiatric disorders and its treatment should be taken into account, and mental-emotional health screening in early pregnancy seems to have much importance.

In analyzing sleep quality trimesters, the results showed that poor sleep quality has a higher prevalence in the third trimester. Sleep quality scales such as sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction were disrupted. A review of sleep quality during pregnancy indicates that sleep problems increase gradually from the first trimester to the last trimester. A research performed

by Swanson *et al.* on pregnant and postpartum women indicated a high prevalence of psychiatric and sleep disorders including insomnia, and anxiety; among which insomnia had a higher frequency in the perinatal period²⁵. Mindell *et al.* examined sleep pattern during pregnancy and showed that the subjects during pregnancy have a poor quality of sleep, decreased sleep efficiency at night, and high daytime sleepiness. Nearly all of the subjects reported repeated awakenings at night, nap during the day, symptoms of insomnia, respiratory disorders, and restless legs syndrome. No difference was seen in terms of sleep-disordered breathing, daytime sleepiness, and fatigue. Furthermore, physical problems related to pregnancy such as frequent urination and lack of convenient

Table I: Socio-Demographic Characteristics of the Participants (n = 565).

No. (%) ^a	Characteristic	No. (%) ^a	Characteristic
	Body mass index (kg/m²)		Age (y)
11 (2.0)	<19.8	6 (1.1)	<18
388 (70.8)	19.8-25.9	152 (27.4)	18-25
125 (22.8)	26-29	194 (35.0)	25-30
24 (4.4)	>29	202 (36.5)	>30
25.2 (2.3)	Mean (SD) ^b	28.7 (5.5)	Mean (SD) ^b
	Husbands education level		Education level
10 (1.8)	Illiterate	19 (3.4)	Illiterate
165 (29.2)	Elementary	151 (26.7)	Elementary
145 (25.7)	Guidance	116 (20.5)	Secondary
38 (6.7)	High school	49 (8.7)	High school
152 (26.9)	Diploma	189 (33.5)	Diploma
55 (9.7)	University	41 (7.3)	University
	Sufficiency of income for expenses		Job
197 (36.2)	Fairly sufficient	549 (98.0)	Housewife
347 (63.8)	Insufficient	11 (2.0)	Employed
	History of abortion		Residence
154 (27.3)	yes	207 (36.6)	Personal
411 (72.7)	no	358 (63.4)	Rental
	History of preterm labor		Place of prenatal care
7 (1.2)	yes	538 (95.9)	Health center
558 (98.8)	no	5 (0.9)	Private clinic
		18 (3.2)	Health center and Private clinic
	Satisfaction of husband job		Marital relationship
202 (35.8)	Fairly satisfied	92 (16.3)	Very good
362 (64.2)	Completely satisfied	368 (65.4)	Good
		103 (18.3)	Fairly good
	Woman interest in fetal sex		Wanted Pregnancy
443 (78.8)	yes	432 (76.5)	yes
122 (21.5)	no	133 (23.5)	no
	Husband interest in fetal sex		History of anxiety
427 (76.3)	yes	2 (0.4)	yes
138 (24.4)	no	563 (99.6)	no

a Valid Percent has been reported in all the variables because of missed data.

b All data indicate number (percent), unless has been specified.

c Two cases reported that the income was completely sufficient.

Table II: Status of Anxiety, Sleep Quality and its Components and Their Relationship (n = 565)

Variable	Mean (SD)	Relationship With Quality of Life	
		r	P
Sleep quality total score	3.6 (1.4)	0.292	<0.001 ^b
Components			
Subjective sleep quality	0.8 (0.4)	0.102	0.016 ^b
Sleep latency	0.8 (0.5)	0.020	NS ^b
Sleep duration	0 (0-0) ^a	0.164	<0.001 ^c
Habitual sleep efficiency	0 (0-0) ^a	0.238	<0.001 ^c
Sleep disturbance	0.8 (0.4)	0.291	<0.001 ^b
Use of sleeping medication	0 (0-0) ^a	0.138	0.001 ^c
Daytime dysfunction	0.9 (0.4)	0.225	<0.001 ^b
Anxiety	4.7(3.7)	-	-

sleep can lead to sleep disturbance. Thus, such sleep disorders during pregnancy should be treated, because sleep disturbance and poor sleep can negatively impact maternal and fetus health after pregnancy²⁶. Sharma et al. reported that sleep disturbance during pregnancy can have a considerable impact on pregnancy out-comes. For example, strong snoring could be a risk factor for hypertension during pregnancy and cesarean section^{27,28}. Moreover, lack of sleep (short and inadequate sleep, and insomnia) during pregnancy leads to low mental and social performance. Poor sleep is a risk factor in creating side effects during pregnancy²⁹. In reviewing the quality of sleep and sleep disturbances during pregnancy, Rezaei et al. reported that poor sleep and poor quality of sleep can be more prevalent in the second trimester of pregnancy³⁰.

There are several researches performed on sleep during pregnancy that can confirm the results obtained from the present research. In the research performed by Rezaei *et al.*, it is indicated that sleep disturbance can be more prevalent in the third trimester of pregnancy³¹, while we found that maternal sleep disturbance is lower in the third trimester. Given the increasing psychiatric problems at the past 3 months of pregnancy, sleep problems and low quality of sleep are more tolerable by women, such that most research con-firms the results obtained from the present research.

We also found that there is a significant correlation between sleep quality and psychiatric dis-orders, and increased level of anxiety and depression would decrease sleep quality. A community-based study by Dorheim et al. on women in week 32 of pregnancy showed that the prevalence of insomnia according to DSM-IV-TR was high (61.9%), significantly higher than the

general population. Dorheim et al. results implied that the symptoms of anxiety are highly correlated with insomnia, including sleep duration of 5 or 10 hours, sleep efficiency < 75%, everyday sleep disturbances, and long sleep with a delayed onset in late pregnancy^{32,33}.

As sleep may be disrupted due to anxiety and available evidence, there is a definite association between the variables, and it is of significance to address maternal emotional and mental health in the early pregnancy. Along with routine prenatal care and treatments, psychiatric and psychological treatments should be done leading to the mental and physical health of pregnant women, future mothers, and newborns.

Conclusion

Due to the high prevalence of mental disorders in pregnant mothers and its significant effect on the fetus, it is recommended to pay attention to the problems that increase vulnerability and affect the sleep rhythm of pregnant mothers.

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Interests conflict

The authors declare no conflict of interest.

References

1. Lee KA, Gay CL. Sleep in late pregnancy predicts length of labor and type of delivery. *Am J ObstetGynecol* 2004; 191: 2041-6.
2. Kryger MH, Roth T, Dement WC. Principles and practice of sleep medicine. 6th ed. Philadelphia, PA: US Elsevier, 2017.
3. Lopes EA, Carvalho LB, Seguro PB, Mattar R, Silva AB, Prado LB, Prado GF. Sleep disorders in pregnancy. *Arq Neuropsiquiatr*. 2004 Jun;62(2A):217-21.
4. Hedman C, Pohjasvaara T, Tolonen U, Suhonen-Malm AS, Myllylä VV. Effects of pregnancy on mothers' sleep. *Sleep Med*. 2002 Jan;3(1):37-42.
5. Elliott AC. Primary care assessment and management of sleep disorders. *J Am Acad Nurse Pract* 2001; 13: 409-17.
6. Okun ML, Roberts JM, Marsland AL, Hall M. How disturbed sleep may be a risk factor for adverse pregnancy outcomes. *Obstet Gynecol Surv*. 2009 Apr;64(4):273-80.
7. Guendelman S, Pearl M, Kosa JL, Graham S, Abrams B, Kharrazi M. Association between preterm delivery and pre-pregnancy body mass (BMI), exercise and sleep during pregnancy among working women in Southern California. *Matern Child Health J*. 2013 May;17(4):723-31.
8. Amir Ali Akbari S, Bolouri B, Sadegh Niat Haghghi KH. Impacts of sleeping disturbances in the last month of pregnancy on the length of labor and way of delivery in women referring to the health centers of Saghez, 2006. *J Ilam Univ Med Sci* 2007; 15: 8-16.
9. Dewald JF, Meijer AM, Oort FJ, Kerkhof GA, Bögels SM. The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: a meta-analytic review. *Sleep Med Rev*. 2010;14(3): 179-89
10. Arasteh M, Yousefi F, Sharifi Z. Investigation of sleep quality and its influencing factors in patients admitted to the gynecology and general surgery of besat hospital in Sanandaj. *Med J Mashhad Univ Med Sci*. 2014;57(6):762-9.

11. Tikotzky L, De Marcas G, Har-Toov J, Dollberg S, Bar-Haim Y, Sadeh A. Sleep and physical growth in infants during the first 6 months. *J Sleep Res.* 2010;19(1-Part-I):103-10.
12. Goldberg WA, Lucas-Thompson RG, Geramo GR, Keller MA, Davis EP, Sandman CA. Eye of the beholder? Maternal mental health and the quality of infant sleep. *Soc Sci Med.* 2013;79:101-8.
13. Haghighat M, Mirghafourvand M, Mohammad-Alizadeh-Charandabi S, Malakouti J, Erfani M. The effect of spiritual counseling on stress and anxiety in pregnancy: A randomized controlled clinical trial. *Iran Red Crescent Med J.* 2018;20(4):e64094.
14. Nath A, Venkatesh S, Balan S, Metgud CS, Krishna M, Murthy GV. The prevalence and determinants of pregnancy-related anxiety amongst pregnant women at less than 24 weeks of pregnancy in Bangalore, Southern India. *Int J Women's Health.* 2019;11:241-8.
15. Bazrafshan M, Mahmoodi RA. The relationship between women's anxiety during pregnancy and labor outcomes in Larestan hospitals. *Mandish.* 2009;1(1):1-12.
16. Hasanjanzadeh P, Faramarzi M. Relationship between maternal general and specific pregnancy stress, anxiety, and depression symptoms and pregnancy outcome. *J Clin Diagn Res.* 2017;11(4):VC04.
17. Rahimi f, Ahmadi m, Rosta f, Alavimajd H, Valiani M. Effect of relaxation training on pregnancy anxiety in high risk women. *J Saf Promot Inj Prevent* 2014; 2(3):180-9.
18. Glover V. Maternal depression, anxiety and stress during pregnancy and child outcome; what needs to be done. *Best Pract Res Clin Obstet Gynaecol.* 2014;28(1):25-35.
19. Cardwell MS. Stress: pregnancy considerations. *Obstet Gynecol Surv.* 2013;68(2):119-29.
20. Maryam GA, Shohre GS, Javad K. Effectiveness of hardiness training on anxiety and quality of life of pregnancy women. *Procedia Soc Behav Sci.* 2013;84:1785-9.
21. Shahhosseini Z, Pourasghar M, Khalilian A, Salehi F. A review of the effects of anxiety during pregnancy on children's health. *Mater Sociomed.* 2015;27(3):200.
22. Baird J, Hill CM, Kendrick T, Inskip HM, Group SS. Infant sleep disturbance is associated with preconceptional psychological distress: findings from the Southampton Women's survey. *Sleep.* 2009;32(4):566-8.
23. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28(2):193-213. doi:10.1016/0165-1781(89)90047-4.
24. Mirghafourvand M, Mohammad ACS, Mansouri A, Najafim, Khodabande F. The effect of vitamin d and calcium plus vitamin d on sleep quality in pregnant women with leg cramps: a controlled randomized clinical trial. *J Isfahan Med Sch.* 2015;32(320):2444-53.
25. Signal TL, Paine SJ, Sweeney B, Muller D, Priston M, Lee K, Gander P, Huthwaite M. The prevalence of symptoms of depression and anxiety, and the level of life stress and worry in New Zealand Māori and non-Māori women in late pregnancy. *Aust N Z J Psychiatry.* 2017 Feb;51(2):168-76.
26. Rallis S, Skouteris H, McCabe M, Milgrom J. A prospective examination of depression, anxiety and stress throughout pregnancy. *Women Birth.* 2014 Dec;27(4):e36-42.
27. Swanson LM, Pickett SM, Flynn H, Armitage R. Relationships among depression, anxiety, and insomnia symptoms in perinatal women seeking mental health treatment. *J Womens Health (Larchmt).* 2011 Apr;20(4):553-8.
28. Mindell JA, Cook RA, Nikolovski J. Sleep patterns and sleep disturbances across pregnancy. *Sleep Med* 2015; 16: 483-8.
29. Sharma SK, Nehra A, Sinha S, Soneja M, Sunesh K, Sreenivas V, Vedita D. Sleep disorders in pregnancy and their association with pregnancy outcomes: a prospective observational study. *Sleep Breath.* 2016 Mar;20(1):87-93.
30. Williams MA, Miller RS, Qiu C, Cripe SM, Gelaye B, Enquobahrie D. Associations of early pregnancy sleep duration with trimester-specific blood pressures and hypertensive disorders in pregnancy. *Sleep.* 2010 Oct;33(10):1363-71.
31. Okun ML, Kline CE, Roberts JM, Wettlaufer B, Glover K, Hall M. Prevalence of sleep deficiency in early gestation and its associations with stress and depressive symptoms. *J Womens Health (Larchmt).* 2013 Dec;22(12):1028-37.
32. Rezaei E, Moghadam ZB, Saraylu K. Quality of life in pregnant women with sleep disorder. *J Family Reprod Health* 2013; 7: 87-93.
33. Dorheim SK, Bjorvatn B, Eberhard-Gran M. Insomnia and depressive symptoms in late pregnancy: A population-based study. *Behav Sleep Med* 2012; 10: 152-66.