

THE ROLE OF EMOTIONAL EATING A MEDIATOR IN RELATIONSHIP BETWEEN SLEEP DURATION AND QUALITY WITH CARBOHYDRATE INTAKE AMONG PREGNANT WOMEN

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ABSTRACT

Carbohydrate is one of the nutrients that is needed during pregnancy. Increased demand during pregnancy causes pregnant women to consume carbohydrates in excess, which occurs due to emotional eating. The increment of emotional eating is assumed to be triggered by insufficient sleep duration and poor sleep quality. This study was aimed to investigate the role of emotional eating as mediator in relationship between sleep duration and quality with carbohydrate intake among pregnant women. This study applied an analytic survey with cross-sectional design on 105 pregnant women in the second and third trimesters at Bondowoso District were sampled through multistage random sampling technique. In this study, the exogenous variables were sleep duration and quality. Meanwhile, the endogenous variables were carbohydrate intake. Emotional eating was the mediator. Data were collected using the Emotional Eater Questionnaire (EEQ), Pittsburgh Sleep Quality Index (PSQI), and 3×24 hours food recall. Data were analyzed using path analysis. There was a direct relationship between duration and quality of sleep with emotional eating ($P < 0.001$ dan 0.002). Sleep duration and quality were not directly associated to carbohydrate intake ($P 0.817$ dan 0.724). A direct relationship was shown by emotional eating and carbohydrate intake variables ($P < 0.001$). It is concluded that emotional eating plays a role in the indirect relationship between sleep duration and quality with carbohydrate intake for pregnant women in the second and third trimesters. Pregnant women should be able to regulate sleep patterns and dietary intake.

Keywords: sleep duration, sleep quality, emotional eating, carbohydrate intake, pregnant women

INTRODUCTION

Carbohydrate is one of nutrients needed during pregnancy. The Recommended Daily Intake for carbohydrate total during pregnancy increases to 400 g/day (Kemenkes RI, 2019). Ritchie and Roser (2013) stated that the highest average carbohydrate consumption in the world was found in Egypt, which was 635.2 g/person/day. Indonesia has an average carbohydrate consumption of 502.3 g/person/day. East Java is one of the provinces with 44.2% of sweet food consumption. Sweet food is one type of high-carbohydrate food because it has a high sugar content (Kemenkes RI, 2018). The results of a preliminary study conducted in Bondowoso District showed that the average consumption of total carbohydrates in second and third trimesters of pregnant women was 457.3 g/day.

Excessive carbohydrate total has an adverse effect on maternal and fetus (Wennberg et al., 2016). Xiang et al. (2019) pointed out that the highest peak of carbohydrate consumption occurs

in the second and third trimesters. This is due to excessive sugary and energy-dense foods intake (Teixeira et al., 2018).

Willingness to consume sweet and high-carbohydrate snacks justifies the desire to consume delicious food caused by emotional eating (Blau et al., 2018). People with emotionally eating are unable to distinguish between hunger and a high desire to consume delicious, sweet, and high-carbohydrate foods (Antonioni et al., 2017). Emotional eating also occurs due to an excessive appetite (Kolko et al., 2017).

Insufficient sleep duration (Hill et al., 2020) and poor sleep quality (Geiker et al., 2018) are associated with increased emotional eating. Insufficient sleep duration causes changes in neuroendocrine and metabolic functions that might modify hormone secretion, which is high levels of ghrelin (appetite stimulating hormone) and low levels of leptin (appetite-suppressing hormone) (Balieiro et al., 2019). Poor sleep quality changes

in hormone secretion might lead to an increase in subjective eating (Saleh-Ghadimi et al., 2019). Further, the changes of neuroendocrine function and ghrelin can result in emotional eating (Balieiro et al., 2019).

Previous research did not focus on the mediator role of emotional eating in pregnant women, and the variables studied were mostly weigh gain during pregnancy. This study aimed to investigate the role of emotional eating as mediator in relationship between sleep duration and quality with carbohydrate intake for pregnant women.

METHODS

This was an analytic study with a cross-sectional design, conducted in Bondowoso District, East Java. The study population was 2,568 pregnant women in the second and third trimesters. Inclusion criteria included pregnant women who settled in the area as stated in their ID cards, were able to communicate well, and able to read and write. Exclusion criteria included pregnant women with hyperemesis gravidarum, chronic energy deficiency, depression history before pregnancy, Diabetes mellitus, cardiovascular disease, cancer, not living with spouse, already gave birth, and withdrawing from this study.

Subjects in this study were 105 pregnant women who were obtained using a multistage random sampling technique. This research was conducted in 12 sub-districts. The calculation of the size of the research subject using the Lemeshow formula (Dahlan, 2013).

$$n = \frac{Z^2_{1-\alpha/2} \times p(1-p) \times N}{d^2(N-1) + Z^2_{1-\alpha/2} \times p(1-p)}$$

The exogenous variables in this study were sleep duration and quality. Meanwhile, the endogenous variable was carbohydrate intake. The mediator variable was emotional eating. The instruments used in this study were the Emotional Eater Questionnaire (EEQ) adopted from Rachmawati (2019), Pittsburgh Sleep Quality Index (PSQI) adopted from Jumiarni (2018), and a 24-hour food recall form. The questionnaire has been tested for validity and reliability by researchers on the subject of pregnancy in the second and third trimesters. Data on carbohydrate intake, emotional eating, sleep duration and quality, were collected by interview which was conducted through home visits. Carbohydrate intake data were collected three times on non-consecutive days. Data collection was assisted by trained enumerators and uses household size as a measure of food intake. Calculation of carbohydrate intake using *Nutrisurvey software* (2007) and the maximum intake of total carbohydrates for pregnant women is 110% of AKG, or equivalent to 440 grams/day (Gibson, 2005). The score of emotional eating was categorized into non emotional eater, low emotional eater, emotional eater, and very emotional eater (López-Galán and de-Magistris, 2019). The score of sleep duration was categorized into enough and less (<7 hour/night) (Kalmbach et al., 2019), while sleep quality was categorized well and poor (Benloucif et al., 2014).

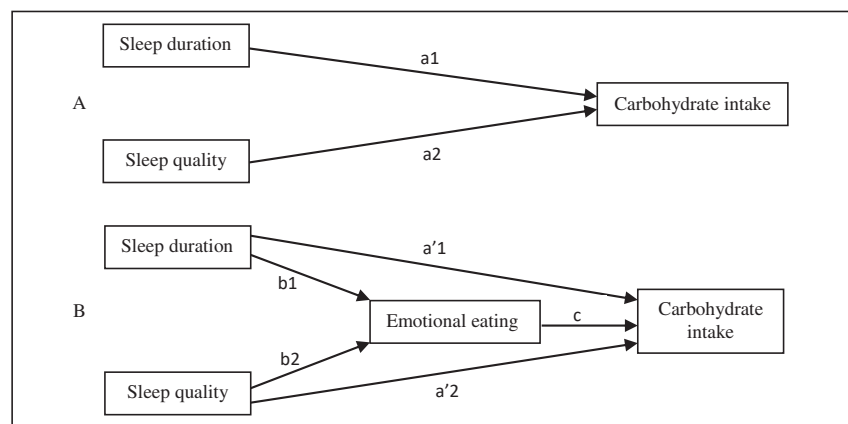


Figure 1. Hypothesized mediation model. (A) Theoretical model of sleep duration, sleep quality, and carbohydrate intake, (B) Theoretical model where emotional eating mediates the relation between sleep duration, sleep quality, and carbohydrate intake.

Pregnant women who were willing to be respondents signed an informed consent form prior to this study. This research had obtained ethical approval from the Ethics Commission of the Jember State Polytechnic (3571/PL17/PG/2021) and permission from the National Unity and Political Agency of Bondowoso District.

The data were analyzed using path analysis with STATA 14 (Ghodang, 2020). Successive interval method used to change ordinal data to interval data. Normality and multicollinearity tests were carried out as initial conditions for determining path analysis. Path analysis suitability was determined using model identification and model suitability tests.

RESULTS AND DISCUSSION

Most of the samples were third semester pregnant women (51.44%). The percentage is not much different because the highest peak of carbohydrate consumption occurs in the second and third trimesters due to the increased consumption of sweet and energy-dense foods (Xiang *et al.*, 2019). One of the causes of the highest dietary intake is environmental factors (Wesołowska *et al.*, 2019). Someone who lives at home tends to experience an increase in dietary intake due to the availability of food in their environment (Teixeira *et al.*, 2018). This can be related to the occupation of most respondents who were housewives (81.0%).

The percentage of sample with enough sleep duration was 52.4%, and less sleep duration was 47.6%. This is not in accordance with research conducted by Yu *et al.* (2017) which mentioned that pregnant women in second and third trimesters often experienced sleep disorders therefore, impacting the reduction of sleep duration. The reduction in sleep duration in pregnant women in the second and third trimesters is caused by several factors such as waking up at night, weight gain during pregnancy which causes shortness of breath, fetal movement, and waking up too early (Polo-Kantola *et al.*, 2017).

The majority of samples have experienced poor sleep quality (55.2%). The high-frequency distribution of poor sleep quality was caused by increasing gestational age, especially in the third

Table 1. Distribution of Sleep Duration, Sleep Quality, Emotional Eating, and Carbohydrate Intake

Variables	Frequency	
	n	%
Gestational Age		
Second trimester	51	48.6
Third trimester	54	51.4
Profession		
Health workers	5	4.8
Teacher	8	7.6
Private employees	5	4.8
Trade	1	1.0
Farmers	1	1.0
Housewives	85	81.0
Sleep Duration		
Enough	55	52.4
Less	50	47.6
Sleep Quality		
Well	47	44.8
Poor	58	55.2
Emotional Eating		
Non emotional eater	19	18.1
Low emotional eater	29	27.6
Emotional eater	45	42.9
Very emotional eater	12	11.4
Carbohydrate Intake		
≤ 440 g/day	37	35.2
> 440 g/day	68	64.8

trimester (Wardani *et al.*, 2018). Sleep problems that pregnant women often experience increase along with the gestational age (Yu *et al.*, 2017).

More than half of the respondents belongs to emotional eater (42.9%) and very emotional eater (11.4%). The high level of emotional eating in pregnant women in the second and third trimesters is due to a response to negative emotions such as anxiety, stress, and depression (Konttinen *et al.*, 2019). This negative response causes individuals to be unable to distinguish hunger feelings (Diggins *et al.*, 2015). This impacts the selection of foods either sweet or high in carbohydrates (Antoniou *et al.*, 2017), which are considered to overcome these negative emotions (Konttinen *et al.*, 2019).

Path analysis in Table 2 shows that there was a direct relationship between sleep duration and quality with emotional eating among pregnant women in the second and third trimesters (respectively, $P < 0.001$; $P = 0.002$ and $\beta = 0.51$; $\beta = 0.34$). This was consistent with study by Al-Musharaf (2020) in healthy young Saudi women,

which demonstrated that poor sleep duration and quality was correlated with the high score of emotional eating. Sleep duration less than normal can cause a changes in neuroendocrine function and high levels of ghrelin (appetite stimulating hormone) (Dashti et al., 2015). Further, the changes of neuroendocrine function and ghrelin can result in emotional eating (Balieiro et al., 2019). In addition, the changes can be caused by poor sleep quality due to psychological dysfunction in pregnant woman (Gao et al., 2019), which leads to an increment in subjective eating (Saleh-Ghadimi et al., 2019). The increment of subjective in eating impacts the uncontrolled timing of meals and the amount of dietary intake (Diggins *et al.*, 2015).

Subjective increase in eating based on pathway analysis did not show a direct relationship between sleep quality and carbohydrate intake for pregnant women in the second and third trimesters ($P=0.724$). This findings was in accordance with the research conducted by van Lee et al. (2017), which found that there was no relationship between poor sleep quality and food intake in pregnant women. Sleep quality undirectly effects to the increase carbohydrate intake, but through unhealthy diet patterns (Lindsay et al., 2017). This mechanism can occur because poor sleep quality causes emotional dysregulation (Geiker et al., 2018). Emotional dysregulation alters physiological systems related to leptin (appetite suppressing hormone) and ghrelin (appetite stimulating hormone) so that it occurs in subjective increase in eating (Saleh-Ghadimi et al., 2019).

Sleep duration did not have a direct relationship with carbohydrate intake for pregnant

women in the second and third trimesters ($P=0.817, \beta=-2.90$). It is contradicts the other study by van Lee et al. (2017), which stated that less sleep duration increases food intake. The existence of this negative relationship indicates that adequate sleep duration can also lead to increased carbohydrate intake. This can be caused by other factors such as physical activity, socioeconomic and environmental factors. Insufficient sleep duration causes pregnant women to tend to consume sweet and high-carbohydrate foods (Hill et al., 2020).

High intake of carbohydrates is also triggered by emotional eating (Saleh-Ghadimi et al., 2019). Emotional eating was directly related to carbohydrate intake for pregnant women in the second and third trimesters ($P<0.001; \beta=59.73$). High emotional eating leads to a person's tendency to consume sweet and high-carbohydrate foods (Saleh-Ghadimi et al., 2019). They cannot distinguish hunger and cause appetite increment (Blau et al., 2018).

Emotional eating plays an indirect role in the relationship between duration and quality of sleep on carbohydrate intake for pregnant women in the second and third trimesters. The strength of the direct relationship between sleep duration and carbohydrate intake (2.90) was smaller than that of the indirect relationship (30.18). The direct relationship of sleep quality to carbohydrate intake (4.24) was smaller than the indirect effect (20.52). The strength of indirect relationship indicated that mediator variable had the role. This study accordance with the research conducted by Weiss et al. (2010), which stated that eating patterns

Table 2. Association between Sleep Duration, Sleep Quality, and Carbohydrate Intake in Second and Third Trimester Pregnancy

Direct and Indirect Effect	β	p-value
Direct Effect		
Sleep duration ¹ emotional eating	0.51	<0.001
Sleep quality ¹ emotional eating	0.34	0.002
Sleep duration ¹ carbohydrate intake	-2.90	0.817
Sleep quality ¹ carbohydrate intake	4.24	0.724
Emotional eating ¹ carbohydrate intake	59.73	<0.001
Indirect Effect		
Sleep duration ¹ emotional eating ¹ carbohydrate intake	30.18	<0.001
Sleep quality ¹ emotional eating ¹ carbohydrate intake	20.52	0.006

act as mediator in the relationship sleep duration carbohydrate consumption. Insufficient sleep duration and poor sleep quality cause emotional dysregulation impacting emotional eating (Saleh-Ghadimi et al., 2019). High emotional eating boosts the desire to consume high-carbohydrate and sweet foods (Quick et al., 2015); therefore, carbohydrate intake becomes excessive (Antonioni et al., 2017). Insufficient sleep duration and poor sleep quality causes an increase in appetite and high carbohydrate intake (Geiker et al., 2018).

CONCLUSION

The study showed a direct relationship between sleep duration and quality with emotional eating. However, it was not directly related to carbohydrate intake. The emotional eating variable also showed a direct relationship with carbohydrate intake. Emotional eating plays a role in the indirect relationship between the duration and quality of sleep with carbohydrate intake of pregnant women in the second and third trimesters. Pregnant women should be able to regulate sleep patterns and the food they eat.

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REFERENCES

- Al-Musharaf, S. (2020). Prevalence and predictors of emotional eating among healthy young Saudi Women during the COVID-19 Pandemic. *Nutrients*, 12(2923), 1–17. doi:10.3390/nu12102923.
- Antonioni, E.E., Bongers, P., & Jansen, A. (2017). The mediating role of dichotomous thinking and emotional eating in the relationship between depression and BMI. *Eating Behaviors*, 26, 55–60. doi: 10.1016/j.eatbeh.2017.01.007.
- Balieiro, L.C.T., Gontijo, C.A., Fahmy, W.M., Maia, Y.C.P., & Crispim, C.A. (2019). Does sleep influence weight gain during pregnancy? a prospective study. *Sleep Science*, 12(3), 156–164. doi: 10.5935/1984-0063.20190087.
- Benloucif, S., Orbeta, L., Ortiz, R., Janssen, I., Finkel, S.I., Bleiberg, J., ... Zee, P.C. (2014). Morning or evening activity improves neuropsychological performance and subjective sleep quality in older adults. *Sleep*, 27(8), 1542–1551. doi: 10.1093/sleep/27.8.1542.
- Blau, L.E., Orloff, N.C., Flammerb, A., Slatchb, C., & Hormesa, J.M. (2018). Food craving frequency mediates the relationship between emotional eating and excess weight gain in pregnancy. *Eating Behaviors*, 31, 120–124. doi: 10.1016/j.eatbeh.2018.09.004.
- Dahlan. MS. (2013). *Besar sampel dan cara pengambilan sampel dalam penelitian kedokteran dan kesehatan*. 3rd edition. Jakarta: Salemba Medika.
- Dashti, H.S., Scheer, F.A.J.L., Jacques, P.F., Lamon-Fava, S., & Ordovás, J.M. (2015). Short sleep duration and dietary intake: epidemiologic evidence, mechanisms, and health implications. *Adv Nutr*, 6(6), 648–59. doi:10.3945/an.115.008623.
- Diggins, A., Woods-Giscombe, C., & Waters, S. (2015). The association of perceived stress, contextualized stress, and emotional eating with body mass index in college-aged black women. *Eating Behaviors*, 19, 188–192. doi: 10.1016/j.eatbeh.2015.09.006.
- Gao, M., Hu, J., Yang, L., Ding, N., Wei, X., Li, L., ... Wen, D. (2019). Association of sleep quality during pregnancy with stress and depression: a prospective birth cohort study in China. *BMC Pregnancy and Childbirth*, 19(444), 1-8. doi: <https://doi.org/10.1186/s12884-019-2583-1>.
- Geiker, N.R.W., Astrup, A., Hjorth, M.F., Sjödin, A., Pijls, L., & Markus, C.R. (2018). Does stress influence sleep patterns, food intake, weight gain, abdominal obesity and weight loss interventions and vice versa?. *Obesity Reviews*, 19(1), 81–97. doi: 10.1111/obr.12603.
- Ghodang, H. (2020). *Path analysis (analisis jalur): konsep dan praktik dalam penelitian*. 1st edition. Medan: PT. Penerbit Mitra Grup.
- Gibson, RS. (2005). *Principles of nutritional assesment*. New York: Oxfords University Press.
- Hill, C., Lipsky, L.M., Betts, G.M., Siega-Riz, A.M., & Nansel, T.R. (2020). A prospective study of the relationship of sleep quality and duration with gestational weight gain and fat gain. *Journal of Women's Health*, 00(00), 1–7. doi: 10.1089/jwh.2020.8306.
- Jumiarni. (2018). Perbandingan kualitas tidur menggunakan skala *Pittsburgh Sleep Quality Index (PSQI)* pada pasien gangguan cemas yang

- mendapat terapi benzodiazepin jangka panjang dan jangka pendek. Tesis. Makassar: Universitas Hasanuddin.
- Kalmbach, D.A., Cheng, P., Sangha, R., O'Brien, L.M., Swanson, L.M., Palagini, L., ... Drake, C.L. (2019). Insomnia, short sleep, and snoring in mid-to-late pregnancy: disparities related to poverty, race, and obesity. *Nature and Science of Sleep*, 11, 301–315. doi: <http://doi.org/10.2147/NSS.S226291>.
- Kemenkes RI. (2018). *Laporan Nasional Riset Kesehatan Dasar Tahun 2018*. Jakarta: Badan Penelitian dan Pengembangan Kesehatan.
- Kemenkes RI. (2019). *Peraturan Menteri Kesehatan Republik Indonesia nomor 28 tahun 2019 tentang Angka Kecukupan Gizi Yang Dianjurkan untuk Masyarakat Indonesia*. Jakarta: Kementerian Kesehatan Republik Indonesia.
- Kleiser, C., Wawro, N., Stelmach-Mardas, M., Boeing, H., Gedrich, K., Himmerich, H., & Linseisen, J. (2017). Are sleep duration, midpoint of sleep and sleep quality associated with dietary intake among Bavarian adults?. *Nature Publishing Group*, 71(5), 1–7. doi: 10.1038/ejcn.2016.264.
- Kolko, R.P., Emery, R.L., Marcus, M.D., & Levine, M.D. (2017). Loss of control over eating before and during early pregnancy among community women with overweight and obesity. *International Journal of Eating Disorders*, 50(5), 582–586. doi: 10.1002/eat.22630.
- Kontinen, H., van Strien, T., Männistö, S., Jousilahti, P., & Haukkala, A. (2019). Depression, emotional eating and long-term weight changes: a population-based prospective study. *International Journal of Behavioral Nutrition and Physical Activity*, 16(1), 1–11. doi: 10.1186/s12966-019-0791-8.
- Lindsay, K.L., Buss, C., Wadhwa, P.D., & Entinger, S. 2017. The interplay between maternal nutrition and stress during pregnancy: issues and considerations. *Annals of Nutrition and Metabolism*, 70(3), 191–200. doi: 10.1159/000457136.
- López-Galán, B., & de-Magistris, T. (2019). Testing emotional eating style in relation to willingness to pay for nutritional claims. *Nutrients*, 11(1773), 1–16. doi:10.3390/nu11081773.
- Polo-Kantola, P., Aukia, L., Karlsson, H., Karlsson, L., & Paavonen, E.J. (2016). Sleep quality during pregnancy: associations with depressive and anxiety symptoms. *Acta Obstetrica et Gynecologica Scandinavica*, 96(2), 198–206. doi: 10.1111/aogs.13056.
- Quick, V., Shoff, S., Lohse, B., White, A., Horacek, T., & Green, G. (2015). Relationships of eating competence, sleep behaviors and quality, and overweight status among college students. *Eat Behav*, 19, 15–19. doi: 10.1016/j.eatbeh.2015.06.012.
- Rachmawati, Y. (2019). Hubungan *emotional eating* dan kebiasaan konsumsi makanan jajanan dengan status gizi remaja. Tesis. Surakarta: Universitas Sebelas Maret.
- Ritchie, H. & Roser, M. (2013). *Diet compositions*. Accessed from <https://ourworldindata.org/diet-compositions>.
- Saleh-Ghadimi, S., Dehghan, P., Farhangi, M.A., Asghari-Jafarabadi, M., & Jafari-Vayghan, H. (2019). Could emotional eating act as a mediator between sleep quality and food intake in female students?. *BioPsychoSocial Medicine*, 13(1), 1–9. doi: 10.1186/s13030-019-0154-3.
- Teixeira, J.A., Castro, T.G., Grant, C.C., Wall, C.R., Castro, A.L.D.S., Francisco, R.P.V., ... Marchioni, D.M. (2018). Dietary patterns are influenced by socio-demographic conditions of women in childbearing age: a cohort study of pregnant women. *BMC Public Health*, 18(1), 1–14. doi: 10.1186/s12889-018-5184-4.
- van Lee, L., Chia, A.R., Loy, S.L., Colega, M., Tham, E.K.H., Cai, S., ... Chong, M.F.F. (2017). Sleep and dietary patterns in pregnancy: findings from the GUSTO cohort. *International Journal of Environmental Research and Public Health*, 14(1409), 1-14. doi:10.3390/ijerph14111409.
- Wardani, H.W., Agustina, R., & Astika, E.F.D. (2018). Tingkat kecemasan dengan kualitas tidur ibu hamil primigravida trimester III. *Dunia Keperawatan*, 6(1), 1-10. doi: <http://dx.doi.org/10.20527/dk.v6i1.4946>.
- Weiss, A., Xu, F., Storfer-Isser, A., Thomas, A., Ievers-Landis, C.E., & Redline, S. (2010). The association of sleep duration with adolescents' fat and carbohydrate consumption. *Sleep*, 33(9), 1201-1209. doi: 10.1093/sleep/33.9.1201.
- Wennberg, A.L., Isaksson, U., Sandström, H., Lundqvist, A., Hörnell, A., & Hamberg, K. (2016). Swedish women's food habits during pregnancy up to six months post-partum: a longitudinal study. *Sexual & Reproductive Healthcare*, 8, 31-6. doi: 10.1016/j.srhc.2016.01.006.
- Wesołowska, E., Jankowska, A., Trafalska, E., Kałużny, P., Grzesiak, M., Dominowska, J., ... Polanska, K. (2019). Sociodemographic,

- lifestyle, environmental and pregnancy-related determinants of dietary patterns during pregnancy. *International Journal of Environmental Research and Public Health*, 16(5), 1–15. doi: 10.3390/ijerph 16050754.
- Xiang, M., Zhang, J., Liang, H., Zhang, Z., Konishi, M., Hu, H., ... Sakamoto, S. (2019). Physical activity and dietary intake among Chinese pregnant women: an observational study. *BMC Pregnancy and Childbirth*, 19(1), 1–8. doi: 10.1186/s12884-019-2452-y.
- Yu, Y., Li, M., Pu, L., Wang, S., Wu, J., Ruan, L., ... Jiang, W. (2017). Sleep was associated with depression and anxiety status during pregnancy: a prospective longitudinal study. *Arch Womens Ment Health*, 20(5), 695-701. doi: 10.1007/s00737-017-0754-5.