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DOES EMOTIONAL EATING MEDIATE THE EFFECT OF PHYSICAL ACTIVITY AND SLEEP DURATION ON FAT INTAKE IN PREGNANT WOMEN?

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ABSTRACT

Pregnant women need nutrients, one of which is fat. High fat intake might occur due to emotional eating. Emotional eating and excessive fat intake are assumed to be caused by low physical activity and insufficient sleep duration. This study purposed to investigate whether emotional eating mediates the effect of physical activity and sleep duration on fat intake in pregnancy. This study used an analytic survey method with a cross-sectional approach. The population of this study was pregnant women in the second and third trimesters who lived in Bondowoso Regency. Sampling was conducted with a *cluster* random sampling technique, and 105 subjects were obtained. The research instruments included a 24-hour food recall form, Emotional Eater Questionnaire (EEQ), Pregnancy Physical Activity Questionnaires (PPAQ), and four sleep duration questions from the Pittsburgh Sleep Quality Index (PSQI) form. Statistical test used path analysis. The direct influences in this study were shown by the variables of physical activity and sleep duration on emotional eating (p-values 0.027 and <0.001), and emotional eating on fat intake of pregnant women (p-value <0.001), respectively. Emotional eating can explain the effect of physical activity and sleep duration on fat intake with the indirect effect value greater than that with the direct effect. The conclusion of this study is that there is a role for emotional eating to mediate the indirect effect of physical activity and sleep duration on fat intake. Women who are pregnant should be able to do dietary habit, regulate sleep, and physical activity.

Keywords: pregnant women, physical activity, sleep duration, emotional eating, fat intake

INTRODUCTION

Pregnant women need adequate intake of nutrients during pregnancy, one of which is fat (Eren *et al.*, 2015). The need for fat increases along with gestational age due to the rapid growth and development of the fetus (Darawati, 2017). Fat intake in the second and third trimesters increases by 2.3 g/day, thus meaning the recommended amount is ≤74.03 g/day (Kemenkes RI, 2019). FAO's data (2017) show that the countries with highest fat intake in the world were the United States (US) and Germany, reaching 167.2 g/person/day (Roser and Ritchie, 2017). Indonesia has an average fat intake of 55.3 g/person/day. The results of the Basic Health Research report 2018 showed that East Java was a province with a relatively high fat intake of 48.5% (Kemenkes RI, 2018). A preliminary study by researchers in pregnant women in Bondowoso Regency demonstrated that the average fat intake was 90.4 g/day.

Excessive fat intake in the preliminary study was due to the high number of fried foods such as fried sweet potatoes, cassava chips, and consumption of more than one serving. The research of Xiang *et al.* (2019) shows that excessive oil consumption leads to an increase in fat intake during pregnancy. Fried foods such as fried cassava and fried sweet potato and cassava chips also contribute to a high amount of fat in daily food intake. Cassava and sweet potatoes are the main agricultural products in Bondowoso Regency (Riawati, 2018) .

High fat intake might occur as a result of emotional eating (Zhang *et al.,* 2020). Persons with emotional eating are unable to differentiate hunger due to response on negative emotions and want to consume energy-dense foods such as high-fat snack (Antoniou *et al*., 2017). Pregnant women with high emotional eating tend to have excessive food intake, especially fat due to increment in appetite frequency (Blau *et al.*, 2018). Negative

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emotions are common in pregnant women, which is caused by an increased risk of psychological symptoms that occur during pregnancy (Ahmed *et al.*, 2017).

The increment of high-fat foods intake in pregnant women might be caused by low physical activity due to the positive relationship between depression and stress (Eichler *et al.*, 2019). Low physical activity induces higher emotional eating (Smith *et al.*, 2020). During pregnancy, pregnant women can experience a decrease in physical activity caused by an enlarged stomach and fatigue (WHO, 2014).

High fat intake might also occur due to less sleep duration (Kleiser *et al.*, 2017). Less sleep duration during pregnancy results in changes of hormones secretion, which relates to appetite, high *ghrelin* hormone (stimulate of appetite) and low *leptin* hormone (suppressant of appetite) (Balieiro *et al*., 2019). Changes in hormone secretion induce emotional eating during pregnancy. Pregnant women's sleep length is often disturbed so that the hours of sleep at night are less than normal (<7 hours), which is caused by physical discomfort and pain such as due to weight gain (Hill *et al.*, 2020).

Low physical activity (Wesołowska *et al.*, 2019), less sleep duration (Gong *et al.*, 2017), and negative emotions (Antoniou *et al*., 2017) can increase food consumption, especially of foods high in energy and fat. This increase has an impact on the health of the mother and fetus, one of which is excess weight gain while pregnant (Hirko *et al*., 2020).

There is a study that examined the role of mediator of emotional eating in the effect of physical activity and sleep duration on fat intake during pregnancy. Previous study has focused solely on weight gain. Fat intake in pregnant women is the basis of this study. This study purposed to investigate whether emotional eating mediates the effect of physical activity and sleep duration on fat intake during pregnancy.

METHOD

This research used an analytic survey method with a cross-sectional approach. This study was carried out in Bondowoso Regency, East Java, in June 2021. The population of this study was 2,568 women in their second and third trimesters of pregnancy. This study included 105 pregnant women from 60 villages obtained through a cluster random sampling technique. Inclusion criteria were lived in Bondowoso Regency, were able to read, write and communicate well. Exclusion criteria were pregnant women with chronic energy deficiency, cancer, cardiovascular disease, hyperemesis gravidarum, living apart from spouse, and withdrawing at the time of the study. The screening process was carried out by taking population data of pregnant women from puskesmas in Bondowoso Regency. Then 50% of the sub-districts were selected, and from the sub-districts, 50% of the villages were randomly selected. A calculation of sample allocation in each village was carried out. Sampling was done by lottery. The researcher visited the sample houses that were selected to be screened based on inclusion and exclusion criteria. Subjects were then asked to fill out an informed consent as proof of respondents' willingness to participate in this study.

Exogenous variables were physical activity and sleep duration. The mediator was emotional eating. Meanwhile, the endogenous variable was fat intake. The research instruments included a 24-hour food recall form, Emotional Eater Questionnaire (EEQ), Pregnancy Physical Activity Questionnaires (PPAQ), and four sleep duration questions on the Pittsburgh Sleep Quality Index (PSQI). The questionnaire was validated for validity and reliability before being used in this study. The 24-hour food recall method was carried out three times in a non-consecutive timeframe.

Fat, protein, carbohydrate, and energy intake was considered high when the Recommended Dietary Allowances (RDA) exceeded 110% (Gibson, 2005). López-Galán and de-Magistris (2019) classified emotional eaters as non-emotional eaters, low emotional eaters, emotional eaters, and very emotional eaters. The sleep duration score was divided into two categories: enough and less (<7 hours/night) (Kalmbach *et al.*, 2019). The score of physical activity was categorized into enough (≥436.756 MET-hour/week) and less (≥436.756 MET-hour/week) (Chandonnet *et al*., 2012).

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Data were collected with two techniques. Interview technique aimed to obtain data on fat intake, emotional eating, and sleep duration. Self-report technique aimed to obtain physical activity data. The data collection procedure was carried out by visiting the respondents' house according to the COVID-19 health protocol. The Jember State Polytechnic's Ethics Commission have given their clearance to this study (3350/PL17/PG/2021).

The data analysis techniques used were path analysis with the STATA 14 application. This analysis was used to determine the value of direct and indirect effects between variables.

RESULTS AND DISCUSSION

Pregnant women with fat intake >110% RDA was 72 respondents (68.6%). The highest peak of fat intake occurred in pregnancy might be due to an excessive oil consumption (Xiang *et al.*, 2019). The high fat intake in pregnant women is also caused by surrounding environment and socioeconomics (Wesołowska *et al.*, 2019). Pregnant women who only work at home will spend more time consuming high-fat foods (Xiang *et al.*, 2019). This can be shown by the high distribution of pregnant women of 81.0% as housewives. The majority of respondents (68.6%) were 19-29 years old, with gravidity in first pregnancy (41.0%). The average income of respondents was <1 million IDR (50.5%).

The physical activity of most respondents was included in the less category (70.5%). They only performed household activity with little exercise, which was their habit before pregnancy. Doing exercise before pregnancy can help attain an adequate level of physical activity during pregnancy (Xiang *et al.*, 2019).

The distribution of sleep duration frequency in pregnant women shows little difference. The highest percentage is shown in the category of enough sleep duration (52.4%). Sleep duration can be categorized as sufficient, namely 7-8 hours a night to achieve optimal health (Kalmbach *et al.*, 2019).

Most of the respondents were included in the emotional eaters category (42.9%). Individuals who are emotional eaters have eating behavior according to their mood but are able to control their eating patterns (López-Galán and de-Magistris, 2019). Pregnant women experience a significant increase in the appetite frequency due to changes in mood, which causes emotional eating and increases food intake (Blau *et al.*, 2018).

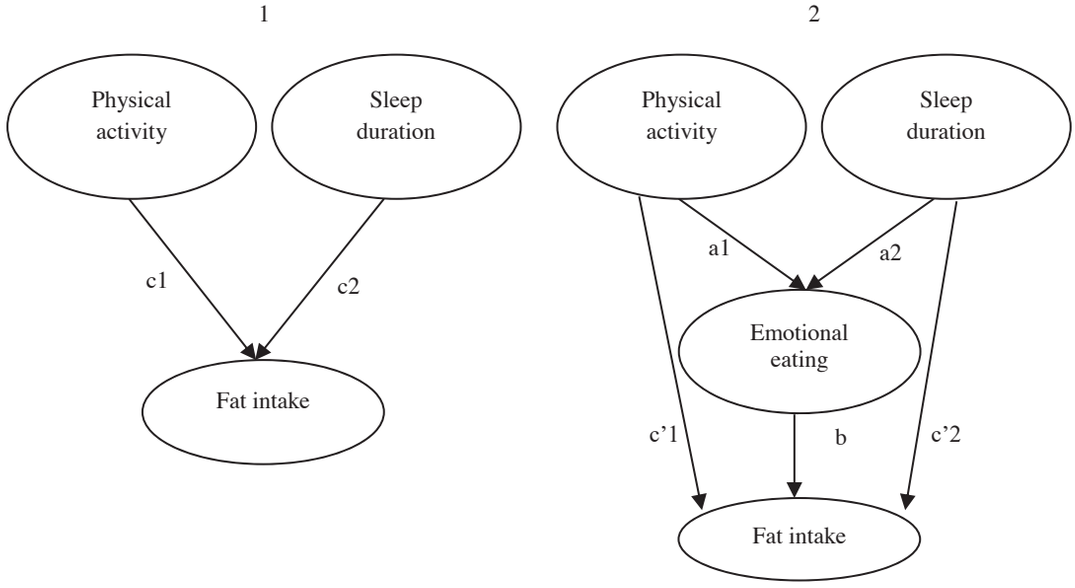

Figure 1. Graphic illustration of emotional eating mediating in the effect of physical activity and sleep duration on fat intake. (1) Physical activity and sleep duration affect fat intake (2) Emotional eating is hypothesized to exert indirect effects physical activity and sleep duration on fat intake.

Table 1. Distribution of Respondents' Characteristic

Variables	Amount (n)	Percentage (%)
Age		
19–29 years old	72	68.6
30–41 years old	33	31.4
Gravidity		
1	43	41.0
2	40	38.1
3	14	13.3
4	6	5.7
5	2	1.9
Profession		
Housewives	85	81.0
Teacher	8	7.6
Health workers	5	4.8
Private employees	5	4.8
Farmers	1	1.0
Trade	1	1.0
Income		
>2 million IDR	35	33.3
1–2 million IDR	17	16.2
<1 million IDR	53	50.5
Physical activity		
Enough	31	29.5
Less	74	70.5
Sleep duration		
Enough	55	52.4
Less (<7 hours/night)	50	47.6
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
Fat intake		
≤ 110% RDA	33	31.4
> 110% RDA	72	68.6
Protein		
≤ 110% RDA	28	26.7
> 110% RDA	77	73.3
Carbohydrate		
≤ 110% RDA	37	35.2
> 110% RDA	68	64.8
Energy		
≤ 110% RDA	34	32.4
> 110% RDA	71	67.6

*IDR=Indonesian Rupiah

Table 2 shows the direct effect of physical activity on emotional eating of pregnant women with a p-value of 0.027 and a large effect of 0.212. This is in line with the findings of the study by Mutiek *et al.* (2021) which states that low physical activity affects the occurrence of emotional eating. Low physical activity causes the serotonin hormone to decrease, which can affect the occurrence of stress and mood disturbances so that it has an impact on the occurrence of emotional eating (Al-Musharaf, 2020). The hormone serotonin plays an important role in regulating emotions and controlling appetite in pregnant women (Eichler *et al.*, 2019). Doing physical activity as recommended can reduce the risk of emotional eating (Richards and Specker, 2020).

Table 2. Direct Effects Between Variables

Direct Effects Between Variables	β	p-value
Emotional eating <-- physical activity	0.212	0.027
Emotional eating <-- sleep duration	0.672	<0.001
Fat intake <-- emotional eating	25.57	<0.001
Fat intake <-- physical activity	2.817	0.493
Fat intake <-- sleep duration	3.168	0.501

Pregnant women's emotional eating can also be directly affected by sleep duration with a p-value <0.001 and the size effect of 0.672. This is consistent with research conducted by Alrefaai *et al*. (2016) which confirms that insufficient sleep is associated with greater emotional eating score in pregnant women with gestational diabetes. Insufficient sleep duration causes emotional dysregulation (Saleh-Ghadimi *et al.*, 2019). This emotional dysregulation leads to the increment of the desire to eat; therefore, it can influence the decision to consume energy-dense, tasty, and high-fat foods (Dashti *et al*., 2015).

This study demonstrates that there is a direct effect of emotional eating on fat intake of pregnant women with a p-value <0.001 and a large effect of 25.57. This is in line with the research of Zhang *et al.* (2020) which shows that emotional eating in pregnant women during the COVID-19 pandemic is associated with increased consumption of oil and high-fat foods. During a negative emotional state, individuals tend to consume high-calorie foods, especially fat, because negative emotions motivate individuals to eat (Alalwan *et al.*, 2019), which eventually causes the increment of appetite frequency (Blau *et al.*, 2018).

Data analysis indicates that physical activity had no effect on fat intake of pregnant women with a p-value of 0.493. The results of this study are inconsistent with the research of Eichler *et al.* (2019) which shows that low physical activity leads to an increase in high-fat foods intake during pregnancy. Low physical activity does not directly affect appetite regulation (Dorling *et al.*, 2018); however, physical activity has a part to play in the mechanism of decreasing serotonin hormone production (Al-Musharaf, 2020). The low serotonin hormone causes a degression in appetite suppressant hormones such as *peptide tyrosine tyrosine* (PYY), *glucagon-like peptide-1* (GLP-1), and *pancreatic polypeptide* (PP) as well as an increase in the hormone *ghrelin* (Quezada *et al.*, 2017).

This study also indicates that there was indirect effect of sleep duration on fat intake of pregnant women with a p-value of 0.501. This result is different from previous study of Hill *et al.* (2020), which mentions that less sleep duration during pregnancy is associated with excess weight gain due to high fat intake. The difference in this study among most of the respondents was having enough sleep. Less sleep duration alters the perception of hunger and appetite through mechanisms of hormonal dysfunction (Córdova *et al*., 2018). This affects individual eating patterns in the form of habit in consuming high-fat foods during guard time (Gong *et al.*, 2017).

The differences between our results and previous findings may be due to other factors. Other factors that also influence the high fat intake in pregnant women are stress and sleep quality during pregnancy, socioeconomic environment, and lifestyle before pregnancy (Wesolowsla *et al*., 2019). It can also be caused by differences of the research instruments. In this study, we used a physical activity questionnaire that reflects time and intensity.

Table 3. Emotional Eating's Role as a Mediator in the Effect of Physical Activity and Sleep Duration on Fat Intake of Pregnant Women.

Variables	β	p-value
Fat intake <-- emotional eating <-- physical activity	5.413	0.037
Fat intake <-- emotional eating <-- sleep duration	17.189	0.000

Based on path analysis results, emotional eating acts as a mediator in the indirect effect of physical activity on fat intake of pregnant women, because it has an indirect effect value of 5.413 which is greater than the direct effect of 2.817, with p-value 0.037. Low physical activity reduces the production of hormone serotonin which results in mood disturbances and poor appetite regulation (Smith *et al.*, 2020). Therefore, it has an impact on emotional eating (Al-Musharaf, 2020). Due to poor appetite regulation, pregnant women with high emotional eating tend to have excessive food intake, especially fat (Blau *et al.*, 2018).

Emotional eating also plays a role in mediating the indirect effect of sleep duration on fat intake of pregnant women with an indirect effect value of 17.189 and p-value < 0.001. This is due to sleep duration, which does not directly affect fat intake. The emotional eating which mediates in an indirect effect of sleep duration on fat intake is due to the mechanism of emotional dysregulation (Al-Musharaf, 2020). This mechanism triggers a person to be unable to differentiate hunger as a result of a negative emotion's response (Antoniou *et al*., 2017), the frequency of appetite increases harshly, and there is a high desire to consume fatty food (Hill *et al.*, 2020), which causes excess fat intake (Blau *et al.*, 2018).

During the COVID-19 pandemic, pregnant women, as a vulnerable group, are advised to reduce outdoor activities and stay indoors. This has an impact on several lifestyle changes, such as reduced physical activity, sleep deprivation, and increased food intake during pregnancy (Whitaker *et al.*, 2021). The existence of the COVID-19 pandemic also has an impact on the psychology of pregnant women (Davenport *et al.*, 2020). Pregnant women are very worried about being infected with COVID-19, which can have an impact on the health of the fetus (Favre *et al.*, 2021). This psychological impact can cause negative emotions (Al-Musharaf, 2020).

The advantage of this study is that it is the first study focused on the role of mediators of emotional eating in the effect of physical activity and sleep duration on fat intake of pregnant women. However, this study has a limitation, specifically that the measured fat intake was non-specific.

CONCLUSION

The direct effect in this study was shown by the variables of physical activity and sleep duration on emotional eating, and emotional eating on fat intake of pregnant women. Emotional eating mediates the indirect effect of physical activity and sleep duration on fat intake. Women who are pregnant should be able to do dietary habit, regulate sleep, and physical activity.

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REFERENCES

Ahmed, A.E., Albalawi, A.N., Alshehri, A.A., AlBlaihed, R.M., & Alsalamah, M.A. (2017). Stress and its predictors in pregnant women: a study in Saudi Arabia. Psychology Research and Behavior Management, 10, 97–102. doi: 10.2147/prbm.s131474.

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.

Alalwan, T.A., Hilal, S.J., Mahdi, A.M., Ahmed, M.A., & Mandeel, Q.A. (2019). Emotional eating behavior among University of Bahrain students: a cross-sectional study. Arab Journal of Basic and Applied Sciences, 26(1), 424–432. doi: 10.1080/25765299.2019.1655836.

Alrefaai, L., Ellison, G.T., Law, G.R., & Scott, E.M. (2016). P128 Self-reported sleep and eating behaviours amongst pregnant women with gestational diabetes. J Epidemiol Community Health, 70, A110. doi: https://jech.bmj.com/content/70/Suppl_1/A110.1

Antoniou, 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.

Blau, L.E., Orloffa, 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.

Chandonnet, N., Saey, D., Alme´ras, N., & Marc, I. (2012). French pregnancy physical activity questionnaire compared with an accelerometer cut point to classify physical activity among pregnant obese women. PLoS ONE, 7(6), 1-9. 10.1371/journal.pone.0038818.

Córdova, F.V., Barja, S., & Brockmann, P.E. (2018). Consequences of short sleep duration on the dietary intake in children: A systematic review and metanalysis. Sleep Medicine Reviews, 42, 68–84. doi: 10.1016/j.smrv.2018.05.006.

Darawati, M. (2017). Gizi ibu hamil. Dalam Hardinsyah & I.D.N. Supariasa (Eds.), *Ilmu gizi: Teori dan aplikasi* (hal. 170-181). Jakarta: Penerbit Buku Kedokteran EGC.

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.

Davenport, M.H., Meyer, S., Meah, V.L., Strynadka, M.C., Khurana, R. (2020). Moms are not OK: COVID-19 and maternal mental health. Frontiers in Global Women's Health, 1(1), 1-6. doi: 10.3389/fgwh.2020.00001

Dorling, J., Broom, D.R., Burns, S.F., Clayton, D.J., Deighton, K., James, L.J., … Stensel, D.J. (2018). Acute and chronic effects of exercise on appetite, energy intake, and appetite-related hormones: the modulating effect of adiposity, sex, and habitual physical activity. Nutrients, 10(1140), 1–21 doi: 10.3390/nu10091140.

Eichler, J., Schmidt, R., Hiemisch, A., Kiess, W., & Hilbert, A. (2019). Gestational weight gain, physical activity, sleep problems, substance use, and food intake as proximal risk factors of stress and depressive symptoms during pregnancy. BMC Pregnancy and Childbirth, 19(1), 1–14. doi: 10.1186/s12884-019-2328-1.

Eren, N.Ş., Şencan, İ., Aksoy, H., Koç, E.M., Kasım, İ., Kahveci, R., … Özkara, A. (2015). Evaluation of dietary habits during pregnancy. Turk Jinekoloji ve Obstetrik Dernegi Dergisi, 12(2), 89–95. doi: 10.4274/tjod.79923.

Favre, G., Pomar, L., Qi, X.L., Nielsen-Saines, K., Musso, D., & Baud, D. (2020). Guidelines for

pregnant women with suspected SARS-CoV-2 infection. Lancet Infect Dis., 20, 652–653. doi: 10.1016/S1473-3099(20)30157-2.

Gibson, R.S. (2005). *Principles of nutritional assesment*. Inggris: Oxfords University Press.

Gong, Q.H., Li, H., Zhang, X.H., Zhang, T., Cui, J., & Xu, G.Z. (2017). Associations between sleep duration and physical activity and dietary behaviors in Chinese adolescents: results from the Youth Behavioral Risk Factor Surveys of 2015. Sleep Medicine, 37, 168–173. doi: http://dx.doi.org/10.1016/j.sleep.2017.06.024.

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.

Hirko, K.A., Comstock, S.S., Strakovsky, R.S., & Kerver, J.M. (2020). Diet during pregnancy and gestational weight gain in a Michigan pregnancy cohort. Current Developments in Nutrition, 4(8), 1–10. doi: 10.1093/cdn/nzaa121.

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.

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.

Mutiek, K.D., Fanani, M., & Nuhriawangsa, A.M.P. (2021). Relationship between stress level, physical activity, and consumption pattern of magnesium with emotional eating in overweight adolescents. Atlantis Press: Advances in Health Sciences Research, 34, 50–53. doi: https://doi.org/10/2991/ahsr.k.210127.012.

Quezada, A.D., Macías-Waldman, N., Salmerón, J., Swigart, T., & Gallegos-Carrillo, K. (2017). Physical activity and calorie intake mediate the relationship from depression to body fat mass among female Mexican health workers. International Journal of Behavioral Nutrition and Physical Activity, 14(160), 1–13. doi: 10.1186/s12966-017-0612-x.

Riawati, N. (2018). Strategi pengembangan produk unggulan daerah melalui kebijakan Pemerintah Daerah Kabupaten Bondowoso. Jurnal Natapraja, 6(2), 163–178. doi: https://doi.org/10.21831/jnp.v6i2.24225.

Richards, A.L., & Specker, B.L. (2020). Exploring relationships of eating and physical activity behaviors with sleep behaviors among adult weight loss participants. Topic in Clinical Nutrition, 35(1), 50–61. doi: 10.1097/TIN.0000000000000 198.

Roser, M., & Ritchie, H. (2013). Food supply. Accessed from: https://ourworldindata.org/food-supply.

Smith, K.E., O'Connor, S.M., Mason, T.B., Wang, S., Dzubur, E., Crosby, R.D., … Roemmich, J.N. (2020). Associations between objective physical activity and emotional eating among adiposity-discordant siblings using ecological momentary assessment and accelerometers. Pediatric Obesity, e12720, 1–9. doi: 10.1111/ijpo.12720.

Wesołowska, E., Jankowska, A., Trafalska, E., Kałuzny, 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.

Whitaker, K.M., Hung, P., Alberg, A.J., Hair, N.L., & Liu, J. (2021). Variations in health behaviors among pregnant women during the COVID-19 pandemic. Midwifery, 95, 1-8. doi: https://doi.org/10.1016/j.midw.2021.102929

WHO. 2014. Global strategy on diet, physical activity and health. Accessed from: http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf.

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.

Zhang, J., Zhang, Y., Huo, S., Ma, Y., Ke, Y., Wang, P., & Zha, A. (2020). Emotional eating in pregnant women during the COVID-19 pandemic and its association with dietary intake and gestational weight gain. Nutrients, 12(8), 1–12. doi: 10.3390/nu12082250.