REVIEW ARTICLE

The influence of sleep quality of pregnant women on the incidence of stunting in children: A literature review

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Abstract

Lifestyle changes have significant impact on the pattern of sleep-in pregnant women. Irregular sleep patterns in pregnant women can lead to anaemia and disturbances in the formation of growth hormones, hence, causing interference in the progress and maturation of children, which includes increased potentials for stunted growth. This literature review aims to discuss the influence of the sleep quality of pregnant women on the incidence of stunting of newborns. The methodology in this study techniques is the result of a comprehensive literature review. The data for this study was obtained from three databases, namely Scopus, Google Scholar, and media articles, using specific criteria for inclusion and exclusion. The major findings suggest that pregnant women with suboptimal sleep quality leading to disruptions in haemoglobin and anaemia. This is attributable to a lack of Non-Rapid Eyes Movement (NREM) sleep phase, where the growth hormone is produced. We conclude that the quality of sleep-in pregnant women influences the incidence of stunting in children. *(Afr J Reprod Health 2024; 28 [10s]: 249-258).*

Keywords: Pregnant women; sleep quality; stunting

Résumé

Les changements de mode de vie ont un impact significatif sur les habitudes de sommeil des femmes enceintes. Des habitudes de sommeil irrégulières chez les femmes enceintes peuvent entraîner une anémie et des perturbations dans la formation des hormones de croissance, provoquant ainsi des interférences dans la progression et la maturation des enfants, ce qui inclut un potentiel accru de retard de croissance. Cette revue de la littérature vise à discuter de l'influence de la qualité du sommeil des femmes enceintes sur l'incidence du retard de croissance des nouveau-nés. La méthodologie de cette étude technique est le résultat d'une revue complète de la littérature. Les données de cette étude ont été obtenues à partir de trois bases de données, à savoir Scopus, Google Scholar et d'articles médiatiques, en utilisant des critères spécifiques d'inclusion et d'exclusion. Les principales conclusions suggèrent que les femmes enceintes ont une qualité de sommeil sous-optimale, ce qui entraîne des perturbations du taux d'hémoglobine et de l'anémie. Cela est dû à un manque de phase de sommeil à mouvements oculaires non rapides (NREM), où l'hormone de croissance est produite. Nous concluons que la qualité du sommeil des femmes enceintes influence l'incidence du retard de croissance chez les enfants. *(Afr J Reprod Health 2024; 28 [10s]: 249-258).*

Mots-clés: Femmes enceintes ; qualité du sommeil ; retard de croissance

Introduction

Children are characterized as healthy when they grow and develop adequately[1].The nutritional problem in Indonesia is quite serious, marked by the large number of cases of malnutrition[2]. Stunting is a health problem in Indonesia. After children reach two years of age, the consequences of stunting become almost irreversible[1]. Various factors affect stunting[3]. Presidential Regulation Number 72 of 2021 contains a plan to accelerate thereduction in stunting rates over the next five years with a target of accelerating stunting reduction to around 14% in 2024[4]. The prevalence of stunting in Indonesia was still high at 24.4% based on the 2021 Indonesian Nutritional Status Study[5].

One of the causes of stunting is inadequate nutritional intake, and recurrent and chronic infections that occur in the first thousand days of life. Pregnancy is a complicated and well-coordinated physiological process, including the formation of the fetus and appendages involving placenta and the systematic adaptation of the maternal organs[6]. Malnutrition accounts for almost 33% of child

fatalities and contributes to 11% of the overall global illnessburden[7].

One of the basic needs that humans need is sleep[8]. But many of us don't get good quality sleep. Sleep and immunity are bidirectionally linked. Immune system activation alters sleep, and sleep in turn affects the innate and adaptive arm of our body's defense system[9]. Nearly half of pregnant women (45.7%) encounter substandard sleep quality[10]. There is a relationship between anxiety experienced by pregnant women and sleep quality[11]. Various factors, including age and gender, might influence the quality of sleep[12]. Pregnancy-related hormonal and physical changes caused sleep difficulties in expectant mothers, particularly in the second half of the pregnancy[13]. Irregular sleep patterns or lack of sleep-in pregnant women can disrupt the child's development, including the risk of stunting. Increased maternal stress experienced during the pre- natal period increases glucocorticoid secretion, which may disrupt circadian activity of the developing fetus[14]. Poor sleep quality can also negatively impact quality of life and functional outcomes (e.g., difficulty in concentrating and participating in social activities)[15]. Good or bad sleep quality can affect mood and body health in the long term[12]. Poor sleep quality is usually caused by several factors, for example insomnia, sleep apnea, snoring, circadian rhythm disorders, shift work systems, parasomnias, etc[8]. Pregnant Chinese women had a notable and high prevalence of poor sleep quality,depression symptoms, and thoughts of harming themselves[16]. A good night's sleep is a night with adequate sleep duration of seven until eight hours for individuals. It provides effective time for homeostatic revitalizing processes that is characterized by generally good quality of the whole sleep period. The prevalence of insomnia is reduced by hypnotic treatment[15]. Sleep phases are divided into two, namely sleep with rapid eye movement or REM and non-rapid eye movement (NREM) sleep[16]. The somatotropic axis is intricately involved in normal sleep, as evidenced by the fact that hypothalamic growth hormone-releasing hormone (GHRH) has sleep promoting effects and pituitary growth hormone (GH) release is strongly associated with slow-wave sleep (SWS). Growth hormones produced in SWS is important forgrowth. Non-REM sleep consists of stages 1, 2, 3, and 4, each of which has its own unique brain activity. Stages 3 and 4, which predominantly happen during the first third of nightly sleep, are known as SWS and are considered the deep stages of sleep. Non-REM begins first, progresses through its stages, and subsequently REM sleep occurs[17].

Pregnancy and the transition to parenthood is an important period marked by dramatic neurobiological and psychosocial changes that may have implications for the health of women[18]. One of the basic needs that must be met during pregnancy is good quality sleep. Assessment of well-being during pregnancy helps in the assurance of better future for both the mother and the child[18]. Maintaining well-being during pregnancy is important, whichwill contribute to promoting maternal health. Fulfilled sleep needs will have an impact on emotional mental balance and maintenance of the physiological balance of various body systems contributing to the health and well-being of pregnant women and their fetuses[19]. Everyone's sleep needs are different, including during pregnancy. The physiology of pregnancy is characterized by hormonal, cardiovascular, respiratory, and muscular-skeletal changes that are associated with the modification of both the morphology and function of several organ systems[20]. Insomnia is highly prevalent in the last trimester of pregnancy. Sleep disorders are often neglected among pregnant women. Sleep disturbances can cause mental and physical problems in pregnant women, resulting in problems for the fetus[21]. There exists a correlation between the quality of sleep and the occurrence of mental health issues. Sleep was linked to alterations in cognitive and emotional functions, such as anxiety or stress levels[16]. Sleep is crucial for optimal brain function and mental well-being[22]. Research has indicated that the occurrence of depression during the perinatal period has an influence on a mother's capacity to effectively offer nutritional care for both her and her infants and young children. Consequently, this could have an adverse impact on the nutritional condition of these susceptible individuals, leading to inadequate development, such as stunted growth, which is presently a significant public health

concern in low- and middle-income countries (LMICs)[23].

The aim of this literature review is to give education about the importance of maternal sleep quality for preventing stunting.

Methods

The study consisted of a review of the current literature by the authors searching a number of indexed bases for articles, journals. Using a search engine, the literature was examined to obtain journal articles from Google Scholar and PubMed. A compilation of relevant articles was identified and explored. As shown in Figure 1, the identification and screening of articles were done using the Prisma approach. Of the 2895 articles from the first identification, 10 were included quantitative and literature review articles (n = 10) were deemed suitable for inclusion for achieving the objectives of the study. The procedure consisted of looking up the journal articles in the database by utilizing number of keywords such as pregnant women, stunting, and sleep quality. The database search was restricted to research and review publications published within the five years period 2019 to 2023 in both Indonesian and English languages. stunting, pregnant women, and sleep quality were among the publications that were screened for inclusion and rejection based on predetermined criteria. Articles were excluded if they investigated sleep quality in man, elderly, and teenagers.

The articles collected were based on the keywords "pregnant women" and/or "pregnant female"; "sleep quality"; "stunting". Articles read at a glance, if they contain these 3 keywords, then look specifically to see whether they suit the purpose and produce a theme. The theme of the literature review was pregnant poor sleep quality, with sub themes.

Results

Based on the findings of an examination of ten different types of literature from a variety of information sources, including scientific research publications and pieces discussing therelationship between the quality of pregnant women's sleep and stunting events, the resultsare revealed in Table 1. The theme of this study reveals 3 themes that describes below:

There are three themes from articles that was reviews that described as below:

Theme 1: Reason of sleep quality changes

Hormonal changes during pregnancy occur due to changes in the function of the reproductiveorgans, cause discomfort for pregnant women which affects their sleep patterns. Extremes of sleep duration, poor sleep quality, sleep disordered breathing are also associated with several harmful conditions in pregnancy[24]. Endocrine changes during pregnancy effect to the quality of sleep[25].The gestational age progresses, the diaphragm is pressured by the enlarging uterus[26]. This makes pregnant women less comfortable when resting and disrupts the quality of sleep[21].

Theme 2: Effect of sleep quality changes

Changes in sleep quality are related to the health condition of pregnant women[27]. Anaemia isthe most common problem of pregnant women and is a world problem[28],[29]. Pregnant women who experience chronic energy deficiency have been shown to be associated with premature births and babies born with low birth weight[30],[31]. The number of parities has also been provento have a risk of giving birth to premature or low birth weight babies[32]. Maternal sleep duration of 9.0–9.9 h was significantly associated with the decreased incidence of low-birth-weight infants andsmall for gestational age infants in pregnant women with appropriate gestational weight gain, compared withthat of 6.0–7.9 h[33].

Theme 3: Effort to reduce stunting

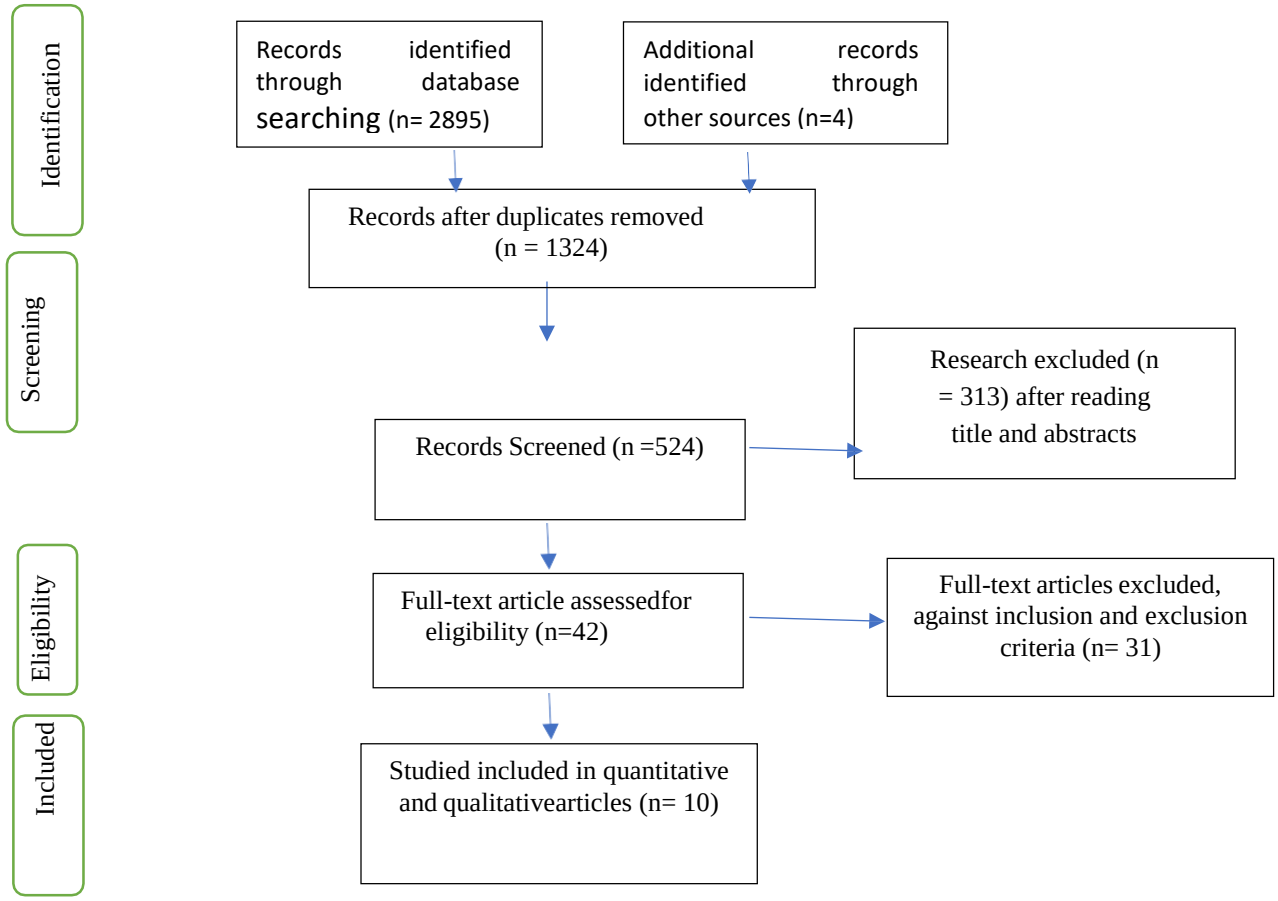
The Indonesian government has made efforts to reduce stunting rates by increasing the amount of antenatal care to 6 times during pregnancy, providing 90 iron tablets, and folic acid[31],[34]. Beside it, there is a need for health education for pregnant

Table 1: Summary of literature on pregnant women's sleep quality and stunting

Author(Years)	Title	Types of research	Instrument	Sample/object	Result
Qin L, Luo Y, Chang H, *et al (*2023)	The association between serum orexin-A levelsand sleep quality in pregnant women.	Quantitative research	Experiment	Pregnant women	Hormone changes in mothers might occur during pregnancy. In order to support foetal growth, maternal oestrogen and progesterone levels rise throughout pregnancy. These endocrine changes result in changes to the quality of sleep.
Diah A, UmmuA, Wahyu A, *et al*. (2021)	Risk factors of anaemia among pregnant womenin communityhealth centre(Puskesmas) Singgani and Puskesmas Tipo Palu	quantitative	case-control study design	Pregnantwomen	Stunting can be avoided by educating the prospective parents about pregnancy preparation and advising expectant mothers to monitor their dietary intake, especially regarding iron andfolic acid supplementation.
Elizabeth M. Cassidy, Caitlin P. Bailey, Melissa A. Napolitano,Amita N. Vyas	Sleep duration and chrono type of pregnant women in the United States: An online cross-sectional survey study	Quantitative method	Comparative	Pregnantwomen	Sleep is a vital behaviour that is especially crucial for supporting the health of the mother and unborn child during pregnancy. Thus, it is a public health priority to identify and treat the sleep characteristics duringpregnancy and the differences in maternal child health outcomes that are linked with them.
Isabel Morales Munoza, Timo Partonen (2019)	The role ofparental circadian preference in the onset of sleep difficulties in early childhood	quantitative	longitudinal birth cohort	Pregnantwomen	Maternal circadian preference is related to several sleep difficulties in early childhood, and it may be considered a potential risk factor for the onset of early sleeping problems
Nader Salari, Niloofar Darvishi (2021)	A systematicreview and meta-analysis of Prevalence of insomnia in the third trimester of pregnancy	literature	literature study	Literature	Insomnia was highly prevalent in the last trimesterof pregnancy. While sleep disturbances can causemental and physical problems in pregnant women, they can consequently cause problems for the fetus. Maintaining the physical and mentalhealth of pregnant mothers is very important.

Tsuyoshi Murata, HyoKyozuka, Toma Fukuda (2021)	Maternal sleep Duration and neonatal birthweight: the JapanEnvironment and Children's Study	quantitative	Retro-spectively analysed	Pregnantwomen	Maternal sleep duration of 9.0–9.9 h was significantly associated with thedecreased incidence of low- birth-weight infants andsmall for gestational age infants in pregnant women with appropriate gestational weight gain, compared withthat of 6.0–7.9 h.
Kusrini, Ina Mulyantoro, Donny Kristanto Tjandrarini, Dwi HapsariAshar, Hadi (2021)	Profile of doubleof undernutritionproblem, coexistence with anaemia among pregnant women Indonesia 2018: A cross sectional survey	quantitative	Anthropo-metric measure-ments	National Basic Health Survey	The risk of anaemia in pregnant women withchronic energy malnutritionhas increased more than twice in rural and urban areas
Leung, Wayne Singh, Ishmeet McWilliams, Scout Stockler, Sylvia Ipsiroglu, Osman S.(2020)	Iron deficiencyand sleep –A literature review	literature	A scoping review	Association studies	Iron investigation and supplementation should be considered in patientspresenting with sleep disorders. To investigate the role of ID in sleep in the future, a harmonization of study designs, includingoutcome measures andstandardized iron andinflammation status is necessary
Vionalita, Gisely Permata, Ninoy Tahta (2020)	The Relationship Between Age of Pregnant Womenand Parity with the Incidence ofAnaemia in ThirdSemester PregnantWomen	quantitative	Chi-Square test and Odds Ratio test	Pregnantwomen	There is a significant relationship between age of pregnant women and paritywith the incidence of anaemia. Public Health Center can improve health promotion programs for mothers approaching ageand the number of parities at risk so that the incidence of anaemia can be prevented in third trimester pregnant women.
Smith Fawzi, Mary C. Andrews, Kathryn G. Fink, Günther Danaei, Goodarz McCoy, DanaCharles Sudfeld, Christopher R(2020)	Lifetime economic impact of the burden of childhood stunting attributable tomaternal psychosocial risk factors in 137bw/ middle- income countries	quantitative	comparative riskassessment analysis	low/middle-income countries throughout Asia, Latin America and the caribbean, North Africa and the Middle East, and sub-Saharan Africa.	Focusing on maternal depression may play a keyrole in reducing the burdenof stunting. Overall, addressing psychosocialfactors among perinatal women can have a significant impact on child growth and well-being in thedeveloping world.

Theme	Sub-themes
Reason of sleep quality changes	Hormonal changeGestational Ages Change pregnancy circadian preference
Effect of sleep quality changes	Anaemia Chronic energy malnutritionNumber of parities
Effort to reduce stunting	Additional Iron tabletAdditional Folic Acid Good information for good diet Supporting times to good sleep



Search keys aimed to retrieve studies of stunting, pregnant women, and sleep quality.

Figure 1: Data abstraction

women and their partners and families to pay attention to nutritional needs so that the nutritional needs of the mother and fetus can be met adequately. Stunting can be avoided by educating the prospectiveparents about pregnancy preparation and advising expectant mothers to monitor their dietary intake, especially regarding iron and folic acid supplementation[35]. Family support is also important to support the mother's emotions to avoid depression in the mother which is at risk of increasing stunting in children. Fulfilled nutritional and sleep needs help pregnant women prevent premature birth and low birth weight, so that stunting can be prevented[35].

Discussion

Sleep is a vital behaviour that is especially crucial for rising the health of mother and unborn child during pregnancy[36]. Lack of mother's sleep has a significant impact to fetus's health. Poor maternal sleep quality contributes to new born hippocampal development[37]. Lack of sleep can affect physiological aspects such as decreased daily activities, fatigue, weakness, slow healing process, unstable vital signs and decreased body endurance. Maternal circadian preference is related to several sleep difficulties in early childhood, and it may be considered a potential risk factor for the onset of early sleeping problems. Maternal circadian preference was associated with infants' circadian rhythm development at three, eight, 18 and 24 months[38]. Maternal lack of sleep duration was significantly associated with the decreased incidence of low-birth-weight infants and small for gestational age infants. Care providers should provide proper counselling regarding the association between maternal sleep duration and neonatal birth weight and suggest comprehensive maternal lifestyle modifications to prevent low birth weight and small for gestational age infants[28]. Short or insufficient sleep duration will have a bad impact on the body, biological processes will be disrupted, haemoglobin formation will be disrupted so that levels become lower than normal values. Multiple studies have examined the correlations between sleep disturbances and the likelihood of hunger[39].

Anaemia in pregnancy is currently a major public health problem worldwide[40]. The prevalence of malnutrition during pregnancy is demonstrated globally in developed countries,including anaemia, stunted, and chronic energy malnutrition. Anaemia is the common type of pregnancy malnutrition. Anaemia was predicted as a determinant factor of maternal mortality rate in pregnant women due to abnormal delivery bleeding or postpartum hemorrhage[29]. Iron deficiency (ID) is associated with sleep disorders. In conclusion, iron investigation and supplementation should be considered in patients presenting with sleep disorders[32]. In pregnant women, lack of sleep can cause anaemia. The Public Health Centre can enhance maternal health promotion initiatives to lower the risk of anaemia in third-trimester pregnant women[33]. Disrupted sleep was identified as a risk factor for anaemia in women[34].

One of the causes of lack of sleep is psychosocial problems. The first 1000 days of life is a period of great potential and vulnerability. Physical growth of children can be affected by the lack of access to basic needs as well as psychosocial factors, such as maternal depression. Focusing on maternal depression may play a key role in reducing the burden of stunting[36]. On South African, mostly reports that user of traditional medicine is pregnant women[37]. Anaemia during pregnancy carries the risk of premature birth, low birth weight, and fetus malformations and can impose additional costs on society and families[38]. Anaemia caused by iron deficiency. Iron is essential for all cellular operations that need oxygen supply, electron transport, and enzyme activity. High metabolic rate cells use more iron and are more likely to become dysfunctional in the event of an iron shortage. During pregnancy, as the mother's blood volume expands and the fetus undergoes development and growth, there is a substantial rise in the demand for iron[39].

Hormone changes in mothers might occur during pregnancy. In order to support foetalgrowth, maternal oestrogen and progesterone levels rise throughout pregnancy. These endocrine changes result in changes to the quality of sleep[40]. Inadequate sleep quality leads to the buildup of harmful compounds, such as free radicals and neurotoxic waste, in the brain. The impact of maternal postnatal depression symptoms and pregnancy intention on children stunting was found to be moderated by social support[41]. It is well established that the quality of a pregnant mother's sleep has a significant impact on the health of her unborn child, increasing the risk of preterm birth and influencing the development of the hippocampus[26]. Research has indicated that social supports, which offer resources, strength, and support during pregnancy, can act as a buffer against stressful life events. Studies shown that a well-balanced diet that includes milk and dairy products is effective in improving sleep quality. The intake of milk and dairy products is mostly measured to promote good sleep qualityand positive effect on

physical and mental health[42]. Conventional knowledge maintains that optimal sleep quality is advantageous for pregnant women and their developing fetuses[43].

Conclusion

Efforts to reduce stunting have challenges such as changes in behaviour, lifestyle, limited access, inequality of resources and social, and cultural changes. The impact of lifestyle changes also affects the sleep quality of pregnant women, which has an impact on the incidence of stunting. Pregnant women are advised to make efforts to manage fatigue, manage stress, consume milk before bed to improve sleep quality, and get hypnotic therapy. Education on the impact of poor sleep quality on pregnant women must also be carried out because it results in anaemia in pregnant women and disruption of the formation of growth hormone in the fetus which can be a cause of stunting. Poor prenatal maternal sleep quality also contributes to new born hippocampal development. Pregnant women can avoid stunting at 1000 HPK by making sure they get enough rest. Overall, addressing psychosocial factors among perinatal women can have a significant impact on child growth and well-being in the developing world. Comprehensive solutions are required, including cross-sector approaches, women's empowerment, policies, and programs that prevent stunting, and targeted and sensitive interventions. Recommended that in addition to having regular visits during pregnancy, pregnant women should also be continuously monitored for sleep-related disorders.

Contribution of authors

Siti Nuriyatus Zahrah: conceptualized, designed the study, wrote the discussion, edited the paper
Nyoman Anita Damayanti: conceptualized, edited the paper, wrote the discussion.

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References

1. Islam MS, Zafar Ullah AN, Mainali S, Imam MA and Hasan MI. Determinants of stunting during the first 1,000 days of life in Bangladesh: A review. *Food Sci Nutr* 2020; 8: 4685–4695.
2. Boucot A and Poinar Jr. G. Stunting. *Foss Behav Compend* 2010; 5: 243–243.
3. Zahrah SN and Damayanti NA. The relationship between religious leaders and the knowledge of mothers in reducing stunting: a literature review. *J Public Health Africa*; 14. Epub ahead of print 2023. DOI: 10.4081/jphia.2023.2622.
4. Kemenkumham. Peraturan Presiden Republik Indonesia Nomor72 Tahun 2021 Tentang Percepatan Penurunan Stunting. 2021; 23.
5. Agushybana F, Pratiwi A and Kurnia PL. Reducing Stunting Prevalence: Causes, Impacts, and Strategies. *BIO Web Conf* 2022; 54: 1–6.
6. Sun F, Wang S and Du M. Functional regulation of decidual macrophages during pregnancy. *J Reprod Immunol* 2021; 143: 103264.
7. Tafesse T, Yoseph A, Mayiso K and Gari T. Factors associated with stunting among children aged 6–59 months in Bensa District, Sidama Region, South Ethiopia: unmatched case-control study. *BMC Pediatr* 2021; 21: 1–11.
8. Vansteenkiste M, Ryan RM and Soenens B. *Basic psychological need theory: Advancements, critical themes, and future directions*. Springer US. Epub ahead of print 2020. DOI: 10.1007/s11031-019-09818-1.
9. Besedovsky L, Lange T and Haack M. The sleep-immune crosstalk in health and disease. *Physiol Rev* 2019; 99: 1325–1380.
10. Lu Q, Zhang X, Wang Y, Li J, Xu Y, Song X, Su S, Zhu X, Vitiello MV, Shi J, Bao Y and Lu L. Sleep disturbances during pregnancy and adverse maternal and fetal outcomes: A systematic review and meta-analysis. *Sleep Med Rev* 2021; 58: 101436.
11. Astuti Y, Afsah Y. The Factors Influencing Sleep Quality of Pregnant Women in Yogyakarta, Indonesia. 2019; 15: 203–206.
12. Yang J, Fu X, Liao X and Li Y. Association of problematic smartphone use with poor sleep quality, depression, and anxiety: A systematic review and meta-analysis. *Psychiatry Res*; 284. Epub ahead of print 2020. DOI: 10.1016/j.psychres.2019.112686.
13. Zhu B, Calvo RS, Wu L, Simon L, Shah K, Piano M, Khain U and Izci-Balserak B. Objective sleep in pregnant women: a comparison of actigraphy and polysomnography. *Sleep Heal* 2018; 4: 390–396.

14. Liu J, Ji X, Rovit E, Pitt S and Lipman T. Childhood sleep: assessments, risk factors, and potential mechanisms. *World J Pediatr*. Epub ahead of print 2022. DOI: 10.1007/s12519-022-00628-z.
15. Barbato G. REM sleep: An unknown indicator of sleep quality. *Int J Environ Res Public Health*; 18. Epub ahead of print 2021. DOI: 10.3390/ijerph182412976.
16. Zhong W, Zhao A, Lan H, Ren Z, Mao S, Zhang J, Li P, Szeto IM, Wang P and Zhang Y. Sleep quality, antepartum depression and self-harm thoughts in pregnant Chinese women. *J Affect Disord* 2023; 327: 292–298.
17. Gohil A and Eugster E. Growth Hormone Deficiency and Excessive Sleepiness: A Case Report and Review of the Literature. *Pediatr Endocrinol Rev* 2019; 17: 41–46.
18. Choi T and Robertson PJ. Contributors and free-riders in collaborative governance: A computational exploration of social motivation and its effects. *J Public Adm Res Theory* 2019; 29: 394–413.
19. Paper C. Well-Being and Pregnancy. 2022; 83–88.
20. LoMauro A, Aliverti A, Frykholm P, Alberico D, Persico N, Boschetti G, DeBellis M, Briganti F, Nosotti M and Righi I. Adaptation of lung, chest wall, and respiratory muscles during pregnancy: Preparing for birth. *J Appl Physiol* 2019; 127: 1640–1650.
21. Salari N, Darvishi N, Khaledi-Paveh B, Vaisi-Raygani A, Jalali R, Daneshkhah A, Bartina Y and Mohammadi M. A systematic review and meta-analysis of prevalence of insomnia in the third trimester of pregnancy. *BMC Pregnancy Childbirth* 2021; 21: 1–8.
22. Zou P, Wang X, Sun L, Liu K, Hou G, Yang W, Liu C, Yang H, Zhou N, Zhang G, Ling X, Liu J, Cao J, Ao L and Chen Q. Poorer sleep quality correlated with mental health problems in college students: A longitudinal observational study among 686 males. *J Psychosom Res* 2020; 136: 110177.
23. Asare H, Rosi A, Scazzina F, Faber M, Smuts CM and Ricci C.Maternal postpartum depression in relation to child undernutrition in low- and middle-income countries: a systematic review and meta-analysis. *Eur J Pediatr* 2022; 181: 979–989.
24. Beroukhim G, Esencan E and Seifer DB. Impact of sleep patterns upon female neuroendocrinology and reproductive outcomes: a comprehensive review. *Reprod Biol Endocrinol* 2022; 20: 1–17.
25. Qin L, Luo Y, Chang H, Zhang H, Zhu Z, Du Y, Liu K and Wu H. The association between serum orexin-A levels and sleep quality in pregnant women. *Sleep Med* 2023; 101: 93–98.
26. LoMauro A and Aliverti A. Respiratory physiology in pregnancy and assessment of pulmonary function. *Best Pract Res Clin Obstet Gynaecol* 2022; 85: 3–16.
27. Wardani HW, Agustina R and Damayanti EAF. Tingkat Kecemasan dengan KualitasTidur Ibu Hamil Primigravida Trimester III. *Dunia Keperawatan* 2018; 6: 1.
28. Efendi F, Israfil I, Ramadhan K, et al. Factors associated with receiving iron supplements during pregnancy among women in Indonesia. *Electron J Gen Med* 2023; 20: 1–7.
29. Kusrini I, Mulyantoro DK and Tjandrarini DH. Profile of double of undernutrition problem, coexistence with anemia among pregnant women indonesia 2018: A cross sectional survey. *Open Access Maced J Med Sci* 2021; 9: 1250–1255.
30. Wahyuni T and Rungreangkulkij S. Exploring children ' s condition of adolescent mothers in East Kalimantan Indonesia : an ethnography study. *J Ners* 2023; 18: 131–144.
31. Alfarisi R, Nurmalasari Y and Nabilla S. Status Gizi Ibu Hamil Dapat Menyebabkan Kejadian Stunting Pada Balita. *J Kebidanan Malahayati* 2019; 5: 271–278.
32. Vionalita G and Permata NT. The Relationship Between Age of Pregnant Women and Parity With the Incidence of Anemia in Third Semester Pregnant Women. 2020; 30: 125–128.
33. Murata T, Kyozuka H, Fukuda T, Yasuda S, Yamaguchi A, Morokuma S, Sato A, Ogata Y, Shinoki K, Hosoya M, Yasumura S, Hashimoto K, Nishigori H, Fujimori K and Japan Environment and Children's Study (JECS) Group. Maternal sleep duration and neonatal birth weight: the Japan Environment and Children's Study. *BMC Pregnancy Childbirth* 2021; 21: 1–9.
34. Kementrian Kesehatan RI. *Buku KIA Kesehatan Ibu dan Anak*. 2020.
35. Pusporini AD, Salmah AU, Wahyu A, Seweng A, Indarty A, Suriah, Nur R, Syam A and Mahfudz Risk factors of anemia among pregnant women in community health center (Puskesmas) Singgani and Puskesmas Tipo Palu &. *Gac Sanit* 2021; 35: S123–S126.
36. Smith Fawzi MC, Andrews KG, Fink G, Danaei G, McCoy DC, Sudfeld CR, Peet ED, Cho J, Liu Y, Finlay JE, Ezzati M, Kaaya SF and Fawzi WW. Lifetime economic impact of the burden of childhood stunting attributable to maternal psychosocial risk factors in 137 low/middle-income countries. *BMJ Glob Heal* 2019; 4: 1–11.
37. Cassidy EM, Bailey CP, Napolitano MA and Vyas AN. Sleep duration and chronotype of pregnant women in the United States: An online cross-sectional survey study. *Prev Med Reports* 2023; 31: 102088.
38. Nevarez-Brewster M, Demers CH, Mejia A, Haase MH, Bagonis MM, Kim SH, Gilmore JH, Hoffman MC, Styner MA, Hankin BL and Davis EP. Longitudinal and prospective assessment of prenatal maternal sleep quality and associations with newborn hippocampal and amygdala volume. *Dev Cogn Neurosci* 2022; 58: 101174.
39. Morales-Muñoz I, Partonen T, Saarenpää-Heikkilä O, Kylliäinen A, Pölkki P, Porkka-Heiskanen T, Paunio

T and Paavonen EJ. The role of parental circadian preference in the onset of sleep difficulties in early childhood. *Sleep Med* 2019; 54: 223–230.
40. Hui Y, Wang X, Yu Z, Feng H, Li C, Mao L, Fan X, Lin L, Cui B, Chen X, Sun L, Wang B and Sun C. Relationship Between Sleep–Wake Disturbance and Risk of Malnutrition in Hospitalized Patients With Cirrhosis. *Front Nutr* 2021; 8: 1–9.
41. Darmawati D, Nizwan-Siregar T, Hajjul K and Teuku T. Exploring Indonesian mothers' perspectives on anemia during pregnancy: A qualitative approach. *Enfermería Clínica (English Ed* 2022; 32: S31–S37.
42. Komada Y, Okajima I and Kuwata T. The effects of milk and dairy products on sleep: A systematic review. *Int J Environ Res Public Health* 2020; 17: 1–13.
44. Yang SY, Lan SJ and Yen YY. Effects of Exercise on Sleep Quality in Pregnant Women: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Asian Nurs Res (Korean Soc Nurs Sci)* 2020; 14: 1–10.