narra j

Short Communication

Determinants of chronic energy deficiency (CED) incidence in pregnant women: A cross-sectional study in Banyumas, Indonesia

Erna K. Wati[1*], Retno Murwani[2], Martha I. Kartasurya[3] and Sulistiyani Sulistiyani[3]

[1]Doctoral Program, Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia; [2]Departement of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Semarang, Indonesia; [3]Faculty of Public Health, Universitas Diponegoro, Semarang, Indonesia

*Corresponding author: ernapurwoko@gmail.com

Abstract

Chronic energy deficiency (CED) in pregnant women is a condition of energy and protein deficiency that lasts for years and causes problems in the mother and fetus. Due to its significant consequences, determining the determinants associated with CED incidence is of utmost importance. The aim of this study was to determine the determinants of the incidence of CED in pregnant women in Indonesia. A cross-sectional study was conducted on pregnant women in Banyumas, Central Java, Indonesia, in 2022. Plausible determinants included maternal age, pregnancy interval, parity, educational attainment, nutritional knowledge, employment, frequency of antenatal care (ANC), and nutritional intake. The Chi-squared test followed by multivariate logistic regression were used to determine the factors associated with the incidence of CED. Our data indicated that 32% of the pregnant women had CED. Univariate analysis found that maternal age (p=0.022), pregnancy interval (p=0.009), educational attainment (p=0.012), knowledge of nutrition and CED (p=0.023), frequency of utilization of ANC services (p=0.028), energy intake (p=0.002), protein intake (p=0.006), vitamin C intake (p=0.016), folate intake (p=0.011), and calcium intake (p=0.004) were significantly associated with CED incidence in the pregnant women. Multivariate analysis indicated that extreme maternal age (OR; 3.49; 95%CI: 1.10–11.05), low educational attainment (OR: 4.12; 95%CI: 1.37–12.33), short pregnancy interval (OR; 7.30; 95%CI: 1.84–28.99), low frequency of ANC (OR: 3.06; 95%CI: 1.01–9.19) and low protein intake (OR: 6.80; 95%CI: 1.62–28.59) were associated with CED incidence. This study underscores the importance of increasing nutritional intake, frequency of ANC, and pregnancy interval among pregnant women to reduce the risk of CED and its adverse health outcomes.

Keywords: Pregnancy, nutritional status, chronic energy deficiency, risk factor, determinant

Introduction

One prevalent nutritional challenge encountered by pregnant women is chronic energy deficiency (CED), which manifests as a consequence of enduring malnutrition and is characterized by a reduced mid-upper arm circumference (MUAC) of less than 23.5 cm [1]. Malnutrition repercussions on expectant mothers extend to both maternal and fetal health, encompassing high risks of anemia, hemorrhage, and inadequate weight gain during gestation, along with prolonged and challenging labor, preterm birth, postpartum bleeding, and compromised fetal development [2]. These adverse outcomes can contribute to miscarriages, congenital abnormalities, and infants born with low birth weight [2].

https://narraj.org/

Received: March 1, 2024 - Accepted: April 22, 2024 - Published online: April 25, 2024

Approximately 20% of cases of stunted growth originate during fetal development in mothers afflicted by malnutrition, failing to receive sufficient nourishment requisite for optimal fetal growth and development [3]. Stunting initiates antecedent to childbirth, underscoring the importance of initiating preventative measures during antenatal care. Offspring born to mothers experiencing CED exhibit a 1.6% elevated likelihood of experiencing stunted growth compared to infants born to non-CED mothers [4]. This underscores the critical role of maternal nutritional status in fetal development and the imperative for early intervention to mitigate such adverse outcomes [4].

The findings from the Indonesian Basic Health Research (*Riskesdas*) conducted in 2018 revealed that 17.3% of pregnant women nationwide had CED, with the prevalence reached 20.2% in Central Java Province [5]. Conversely, the health profile of Banyumas Regency in 2020 documented a markedly higher prevalence of CED among pregnant women, at 36.6% [6]. This high prevalence is closely linked to inadequate consumption of nutritious food during pregnancy, along with a lack of maternal knowledge regarding optimal dietary practices for ensuring adequate nutrition during gestation [7].

The determinants contributing to CED incidence in pregnant women encompass both direct and indirect factors. Direct determinants primarily involve insufficient intake of energy and protein-rich food sources, along with susceptibility to infectious diseases [8,9]. Indirect determinants include a broad array of factors, including maternal age, parity (number of previous pregnancies), educational attainment, level of knowledge regarding nutritional requirements, employment status, household income, expenditures on food, availability of nutritious food options, and frequency of antenatal care (ANC) attendance [9]. These multifaceted influences collectively contribute to the prevalence and severity of CED among pregnant women [10]. Prolonged consumption of inadequately nutritious food during pregnancy, failing to fulfill energy and protein requirements, or encountering health issues and deficiencies in essential nutrients can precipitate CED among pregnant women [11]. Such dietary inadequacies compromise the body immune defenses, heightening susceptibility to viral infections. Moreover, they could impede optimal nutrient utilization, exacerbating the impact of insufficient food availability, substandard hygiene practices, and poor dietary choices, collectively contributing to the development and persistence of CED during pregnancy [12]. The consumption behaviors of expectant and pregnant women are significantly shaped by factors such as food availability, cultural practices, and familial norms, which, over time, contribute to the establishment of household dietary habits [13]. Data from the 2014 Indonesian Total Diet Survey [14] revealed that a notable proportion of pregnant women, both in rural and urban settings, grapple with deficiencies in energy and protein intake. Identified issues in consumption patterns among pregnant women encompass inadequacies in macronutrient consumption, insufficiencies in animal protein, limited intake of fruits and vegetables, and deficits in micronutrient intake [14].

Furthermore, individuals from low socioeconomic backgrounds face heightened vulnerability to food insecurity, thereby exacerbating challenges in accessing and affording nutritious food options [15]. It is worth noting that the risk factors contributing to CED vary across regions, contingent upon community-specific characteristics, prevailing consumption patterns, a socio-economic, and cultural dynamics within the respective communities [16]. This underscores the importance of tailoring interventions to address localized determinants of CED in pregnant women.

Based on the aforementioned challenges, it is evident that the nutritional status of pregnant women constitutes a significant concern in Indonesia. Therefore, the aim of this study was to determine the determinants contributing to the incidence of CED among pregnant women. By identifying these determinants, targeted interventions can be devised and implemented to effectively mitigate the prevalence of CED among pregnant women, thereby ameliorating the nutritional status and overall health outcomes of expectant mothers.

Methods

Study design and sampling

A cross-sectional study was conducted in Banyumas Regency, Central Java Province, Indonesia, spanning from April to June 2022, aiming to identify factors associated with the incidence of CED

in pregnant women. The study sample comprised pregnant women who met predefined inclusion criteria, including attendance at pregnancy check-ups at community health centers and had a maternal and child health (MCH) handbook. Exclusion criteria include mothers who have non-singleton pregnancies, as well as pregnant women who suffer from infectious diseases, hypertension, or HIV.

The minimum sample size was calculated and tailored for testing hypotheses regarding differences in proportions, resulting in a sample size of 100 pregnant women. The selection of sub-districts was based on the highest prevalence of CED in the district (Kembaran and Sumbang). The samples were selected using cluster random sampling, involving randomization of the selection of villages and the selection of participants within each village. This methodological approach ensured the representation of pregnant women across diverse geographical areas within Banyumas Regency.

Data collection and study variables

The data collection was conducted through direct interviews using a structured questionnaire. The independent variable in this study includes maternal age, pregnancy spacing, parity, educational attainment, employment, nutritional knowledge of pregnant women, utilization of ANC services, and nutritional intake (energy and protein, vitamin A, vitamin C, iron, folate, and calcium intake). The pregnancy interval, which indicates the duration between consecutive pregnancies, was classified into two categories: interval less than 24 months and interval greater than 24 months. Nutritional knowledge of pregnant women is the ability of pregnant women to answer correctly 15 statements about pregnancy nutrition and CED. Inadequate if the knowledge score was <76% and adequate if the knowledge score was ≥76%. The utilization of ANC services measured how many times the pregnant women accessed and used the health examination services during their pregnancy. It was categorized as low if less than 2 times during the first and second semesters and high if ≥2 times.

Nutritional intake data was measured utilizing the semi-quantitative food frequency questionnaire (SQ-FFQ) to assess intake over the past month. The SQ-FFQ comprises 160 food items tailored to local dietary practices. Nutritional intake data were then converted into and subsequently analyzed using Nutri Survey 2007 software. Following analysis, energy and protein, vitamin A, vitamin C, iron, folate, and calcium intake were compared with the recommended dietary allowance (RDA) adjusted according to the mother's age and gestational age [17,18]. Energy and protein intake were categorized as insufficient if <80% of the RDA, sufficient if 80–100% of the RDA, and excess if >100% of the RDA. Vitamin and mineral intake were dichotomized into insufficient if <80% of RDA and sufficient if 80–100% of the RDA categories [17].

The dependent variable of the study was the presence of CED. The CED was assessed based on MUAC, which was measured using a LiLA tape with a precision of 0.1 cm. The individual was categorized as CED if MUAC <23.5 cm.

Statistical analysis

Data were analyzed using a Chi-squared test followed by multivariate analysis employing multiple logistic regression to determine the factors associated with the incidence of CED in pregnant women. These analytical techniques enabled the exploration of relationships between independent and dependent variables, thereby providing insight into factors associated with CED among pregnant women in the study. All statistical analyses were performed using SPSS version 25 (IBM, Chicago, IL, USA).

Results

Characteristics of pregnant women

This study involved 100 pregnant women, and data on the characteristics of pregnant women are presented in **Table 1**. The majority of pregnant women (74%) aged between 20–35 years and 79% were in the second trimester of pregnancy. In addition, 83% had pregnancy interval ≥24 months, 78% had parity ≥2 children, 70% had secondary education, and 73% were identified as not working (**Table 1**).

Table 1. Characteristics of pregnant women in the study (n=100)

Variable	Frequency	Percentage
Maternal age		
<20 or >35 years	26	26.0
20 to 35 years	74	74.0
Gestational age		
1st trimester	21	21.0
2nd trimester	79	79.0
Pregnancy spacing		
<24 months	17	17.0
≥24 months	83	83.0
Parity		
<2 children	22	22.0
≥2 children	78	78.0
Educational attainment		
Primary (≤ junior high school)	30	30.0
Secondary (higher than junior high school)	70	70.0
Mother's employment		
Working	27	27.0
Not working	73	73.0
Knowledge on nutritional and CED		
Inadequate	46	46.0
Adequate	54	54.0
Utilization of ANC services		
Low (trimester I and II <2 times)	56	56.0
High (trimester I and II ≥2 times)	44	44.0
Energy intake		
Insufficient	49	49.0
Sufficient	51	51.0
Protein intake		
Insufficient	73	73.0
Sufficient	27	27.0
Vitamin A intake		
Insufficient	19	19.0
Sufficient	81	81.0
Vitamin C intake		
Insufficient	68	68.0
Sufficient	32	32.0
Iron intake		
Insufficient	58	58.0
Sufficient	42	42.0
Folate intake		
Insufficient	60	60.0
Sufficient	40	40.0
Calcium intake		
Insufficient	54	54.0
Sufficient	46	46.0
Chronic energy deficiency (CED)		
Mid-upper arm circumference (MUAC) <23.5 cm	32	32.0
Mid-upper arm circumference (MUAC) ≥23.5 cm	68	68.0

Assessment of knowledge and utilization of ANC services showed that 46% of pregnant women had inadequate knowledge about pregnancy and maternal health, and 56% of participants had utilization of ANC services less than optimal (attending appointments less than twice during their pregnancy) (**Table 1**). The nutritional analysis revealed insufficiency of protein (73%), vitamin C (68%), energy (49%), iron (58%), folate (60%), and calcium (54%) among pregnant women (**Table 1**).

Factors associated with chronic energy deficiency in pregnant women

The research findings indicated that 32% of pregnant women experienced CED. Our univariate suggested that maternal age (p=0.022), pregnancy interval (p=0.009), educational status (p=0.012), nutritional knowledge of pregnant women (p=0.023), utilization of ANC services (p=0.028), energy intake (p=0.002), protein intake (p=0.006), vitamin C intake (p=0.016), folate intake (p=0.011), and calcium intake (p=0.004) were significant associated CED incidence in the pregnant women (**Table 2**).

Table 2. Univariate analysis showing factors associated with chronic energy deficiency in pregnant women (n=100)

Variable	Chronic energy deficiency (CED)				*p*-value
	Yes		No		
	n	%	n	%	
Maternal age					0.022
<20 or >35 years	13	50	13	50	
20 to 35 years	19	25.7	55	74.3	
Pregnancy interval					0.009
<24 months	10	58.8	7	41.2	
≥24 months	22	26.5	61	73.5	
Parity					0.291
<2 children	5	22.7	17	77.3	
≥2 children	27	34.6	51	65.4	
Educational attainment					0.012
Primary (≤ junior high school)	15	50.0	15	50.0	
Secondary (higher than junior high school)	17	24.3	53	75.7	
Mother's employment					0.511
Working	10	37.0	17	63.0	
Not working	22	30.1	51	69.9	
Nutritional knowledge of pregnant women					0.023
Inadequate	20	43.5	26	56.5	
Adequate	12	22.2	42	77.8	
Frequency of utilization of ANC services					0.028
Low (TM I and II <2 times)	23	41.1	33	58.9	
High (TM I and II ≥2 time)	9	20.5	35	79.5	
Energy intake					0.002
Insufficient	23	46.9	26	53.1	
Sufficient	9	17.6	42	82.4	
Protein intake					0.006
Insufficient	29	39.7	44	60.3	
Sufficient	3	11.1	24	88.9	
Vitamin A intake					0.555
Insufficient	5	26.3	14	73.7	
Sufficient	27	33.3	54	66.7	
Vitamin C intake					0.016
Insufficient	27	38.7	41	60.3	
Sufficient	5	15.6	27	84.4	
Iron intake					0.054
Insufficient	23	39.7	35	60.3	
Sufficient	9	21.4	33	78.6	
Folate intake					0.011
Insufficient	25	41.7	35	58.3	
Sufficient	7	17.5	33	82.5	
Calcium intake					0.004
Insufficient	24	44.4	30	55.6	
Sufficient	8	17.4	38	82,6	

Our final multivariate analysis indicated that maternal age, pregnancy interval, educational attainment, frequency of ANC and protein intake were associated with the incidence of CED in pregnant women (**Table 3**). The variable that had the most dominant influence on CED was low pregnancy interval (OR: 7.30; 95%CI: 1.84–28.99). This is followed by low protein intake (OR: 6.80; 95%CI: 1.62–28.59), low educational attainment (OR: 4.12; 95%CI: 1.37–12.33), extreme maternal age (OR: 3.49; 95%CI: 1.10–11.05) and low frequency of ANC services (OR: 3.06; 95%CI: 1.01–9.19) (**Table 3**).

Discussion

CED is characterized by inadequate energy intake over an extended period, particularly prevalent among pregnant women [9]. In this study, it was discerned that 32% of pregnant women encountered CED. This nutritional deficiency could have profound implications for maternal health during pregnancy, predisposing affected individuals to a spectrum of adverse outcomes. Among the potential sequelae are anemia, pregnancy complications, hemorrhage, heightened susceptibility to infectious diseases, and an elevated risk of miscarriage, stillbirth, birth defects, and low birth weight.

Table 3. Final multivariate analysis showing factors associated with chronic energy deficiency (CED) in pregnant women (n=100)

Variable	Total	CED	Adjusted	
	n (%)	n (%)	OR (95%CI)	*p*-value
Maternal age				
<20 or >35 years	26 (26.0)	13 (50.0)	3.49 (1.10–11.05)	0.038
20 to 35 years *(Ref)*	74 (74.0)	19 (25.7)	1	
Pregnancy interval				
<24 months	17 (17.0)	10 (58.8)	7.30 (1.84-28.99)	0.027
≥24 months *(Ref)*	83 (79.0)	22 (26.5)	1	
Educational attainment				
Primary	30 (30.0)	15 (50.0)	4.12 (1.37–12.33)	0.034
Secondary *(Ref)*	70 (70.0)	17 (24.3)	1	
Utilization of ANC services				
Low (TM I and II <2 times)	56 (56.0)	23 (41.1)	3.06 (1.01–9.19)	0.026
High (TM I and II ≥2 times) *(Ref)*	44 (44.0)	9 (17.6)	1	
Protein intake				
Insufficient	73 (73.0)	29 (39.7)	6.80 (1.62–28.59)	0.017
Sufficient *(Ref)*	27 (27.0)	3 (11.1)	1	

The research results showed that the best time to get pregnant is between 20–35 years, as participants within this range of age mostly had no CED. A study reported a significant relationship between age and the incidence of CED in pregnant women [19]. Specifically, pregnant women below 20 years of age may face unique challenges. Biologically, they may not be fully emotionally mature, rendering them susceptible to emotional fluctuations that could compromise their nutritional intake. Consequently, pregnant women at this age may be particularly prone to experiencing CED [20,21].

The study revealed a significant risk factor for CED was a shorter birth interval, specifically less than 24 months. Our data indicated that pregnancies spaced at intervals shorter than 24 months were associated with a 7.3-fold increase in the risk of CED among pregnant women compared to those with birth intervals more than 24 months. The findings suggest that pregnancies occurring too closely and frequently may predispose women to malnutrition. This phenomenon is linked to the depletion of nutritional reserves in the maternal body, exacerbated by the incomplete recovery of reproductive organs post-pregnancy [22]. Our study findings indicated that 70% of pregnant women possessed a secondary level of education, and there was a clear relationship between educational status and CED in pregnant women. In particular, women's educational level has emerged as an important factor influencing nutritional status, with higher educational attainment correlating with increased access to nutritional information [23]. This association underscores the importance of education in shaping food behavior and nutritional decision-making during pregnancy.

Research findings suggest that a lack of knowledge among pregnant women is reflected in deviant eating behavior, while a strong understanding of nutrition facilitates wise food choices and aligns with nutritional needs during pregnancy. Therefore, pregnant women who have good nutritional knowledge will be in a better position to choose nutritious foods that meet their nutritional needs, thereby improving optimal maternal and fetal health outcomes. A higher level of education and knowledge makes it easier for individuals to understand information and apply it to their daily behaviors and lifestyles related to health and nutrition, including understanding nutritious food for pregnant women to prevent nutritional problems [24].

The study results elucidated a statistically significant relationship between the frequency of ANC services and the incidence of CED among pregnant women. This finding aligns with the prior study indicating a correlation between ANC service utilization and maternal condition [25]. Pregnant women experiencing complaints or complications during pregnancy tend to be more vigilant and cautious throughout the pregnancy process [25]

CED in pregnant women stems from an imbalance in nutritional and micronutrient intake. Insufficient energy and protein intake contribute to the depletion of energy reserves in the body, compounded by inadequate consumption of essential nutrients such as protein, fat, carbohydrates, and micronutrients. Prolonged inadequacies in these nutrients can exacerbate CED among pregnant women. Notably, the study revealed that pregnant women exhibited relatively low intake levels of protein, vitamin C, iron, folic acid, calcium, and vitamin C, failing

to meet the RDA for optimal nutrition [25]. Previous studies have established a relationship between the energy intake of pregnant women and the birth weight of their infants [26,27]. It has been observed that mothers with lower energy intake are less likely to deliver infants with low birth weight compared to those with adequate energy intake. In this study, it was found that protein intake had an effect on CED in pregnant women. Increased protein intake in pregnant women is necessary for the growth of maternal and fetal tissue and the placenta [28]. This phenomenon arises from the diminished nutritional provisioning to the fetus, impeding optimal growth and development [29]. These findings underscore the importance of promoting adequate nutritional intake among pregnant women to mitigate the risk of CED and its associated adverse health outcomes.

Conclusion

This study identified that 32% of pregnant women experienced CED. Several determinants of the incidence of CED in pregnant women were extreme maternal age, low educational attainment, short pregnancy interval, low frequency of ANC, and low protein intake. This data suggested that there remains room for knowledge improvement through targeted educational interventions aimed at enhancing understanding of nutritional requirements during pregnancy. Additionally, there is a critical need to intensify routine pregnancy checks to effectively identify and address nutritional and health issues early in pregnancy. By doing so, preventive measures can be implemented to mitigate the risk of CED and other adverse health outcomes during pregnancy, ultimately promoting maternal and fetal well-being.

Ethics approval

This study was approved by the Health Research Ethics Committee, Universitas Jenderal Soedirman, Purwokerto, Indonesia, No. 824/EC/KEPK/VII/2022. All respondents voluntarily signed the informed consent.

Acknowledgments

We thank all collaborators who helped during the data collection process.

Competing interests

All the authors declare that there are no conflicts of interest.

Funding

This study received no external funding.

Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

How to cite

Wati EK, Murwani R, Kartasurya MI, Sulistiyani S. Determinants of chronic energy deficiency (CED) incidence in pregnant women: A cross-sectional study in Banyumas, Indonesia. Narra J 2024; 4 (1): e742 - http://doi.org/10.52225/narra.v4i1.742.

References

1. Kemenkes RI. Petunjuk teknis pemberian makanan tambahan (PMT) berbahan pangan lokal untuk balita dan ibu hamil. Kemenkes. Available from: https://ayosehat.kemkes.go.id/juknis-pemberian-makanan-tambahan-pmt-berbahan-pangan-lokal-untuk-balita-dan-ibu-hamil. Accessed: 12 October 2023.
2. Pandey P, Bajpai P, Jain S, *et al.* Maternal empowerment holds the key to reducing stunting during first 1000 days of life: Evidence from a case-controlled study. Ann Trop Med Public Health 2017;10(3):667-677.
3. Fentahun W, Wubshet M, Tariku A. Undernutrition and associated factors among children aged 6-59 months in East Belesa district, Northwest Ethiopia: A community based cross-sectional study. BMC Public Health 2016;16(1):1-10.

4. Kpewou DE, Poirot E, Berger J, *et al.* Maternal mid-upper arm circumference during pregnancy and linear growth among. Matern Child Nutr 2020;16(S2):e12951.
5. Kementerian Kesehatan RI. Laporan nasional riskesdas 2018. Jakarta: Lembaga Penelitian dan Pengembangan Kesehatan; 2019.
6. Dinas Kesehatan Kabupaten Banyumas. Profil kesehatan kabupaten banyumas tahun 2020. Available from: https://static.banyumaskab.go.id/website/file/website_25062107294960d5cc3de3e1f.pdf. Accessed: 12 October 2023.
7. Marshall NE, Abrams B, Barbour LA, *et al.* The importance of nutrition in pregnancy and lactation: Lifelong consequences. Am J Obstet Gynecol 2022;226(5):607-632.
8. Sediaoetama AJ. Ilmu gizi untuk mahasiswa dan profesi. Jilid II. Jakarta: Dian Rakyat; 2014.
9. Wubie A, Seid O, Eshetie S, *et al.* Determinants of chronic energy deficiency among non-pregnant and non-lactating women of reproductive age in rural Kebeles of Dera District, North West Ethiopia, 2019: Unmatched case control study. PLoS ONE 2020;15(10):1-12.
10. Almatsier S, Soetardjo S, Soekatri M. Gizi seimbang dalam daur kehidupan. Jakarta: Gramedia Pustaka Utama; 2011.
11. Kasim F, Sirajuddin S, Amiruddin R. The effect of *Moringa oleifera* leaf biscuit on the increase of body weight and upper arm circumference for chronic energy deficiency among pregnant women in Bontoramba District Jeneponto Regency. Indian J Public Health Res Dev 2019;10(4):1018.
12. Koletzko B, Godfrey KM, Poston L, *et al.* Nutrition during pregnancy, lactation and early childhood and its implications for maternal and long-term child health: The early nutrition project recommendations. Ann Nutr Metab 2019;74(2):93-106.
13. Kementrian Kesehatan RI. Riset kesehatan dasar (RISKESDAS) 2013. Jakarta: Badan Penelitian dan Pengembangan Kesehatan Kementrian Kesehatan Republik Indonesia; 2013.
14. Kementerian Kesehatan RI. Buku studi diet total: Survei konsumsi makanan individu indonesia 2014. Jakarta: Badan Penelitian dan Pengembangan Kesehatan; 2014.
15. Mohsena M, Mascie-Taylor CN, Goto R. Association between socio-economic status and childhood undernutrition in Bangladesh: A comparison of possession score and poverty index. Public Health Nutr 2010;13(10):1498-1504.
16. Mousa A, Naqash A, Lim S. Macronutrient and micronutrient intake during pregnancy: An overview of recent evidence. Nutrients 2019;11(2):443.
17. Kusharto CM, Supariasa IDN. Survey konsumsi gizi. Yogjakarta: Graha Ilmu; 2014.
18. Penulis T, Sihombing M, Pengantar K. Buku studi diet total: Survei konsumsi makanan individu provinsi riau 2014. Jakarta: Badan Penelitian dan Pengembangan Kesehatan; 2014.
19. Indarti J, Wonodihardjo HS, Sianipar KA, *et al.* Maternal and neonatal outcome in pregnant women with chronic energy deficiency in Cipto Mangunkusumo General Hospital, Indonesia. Open Access Maced J Med Sci 2023;11(B):474-479.
20. Abraham S, Miruts G, Shumye A. Magnitude of chronic energy deficiency and its associated factors among women of reproductive age in the Kunama population, Tigray, Ethiopia, in 2014. BMC Nutr 2015;1(1):1-9.
21. Legesse M, Abebe Z, Woldie H. Chronic energy deficiency and associated factors among older population in Ethiopia: A community based study. PLoS ONE 2019;14(4):1-12.
22. Nausheen S, Bhura M, Hackett K, *et al.* Determinants of short birth intervals among married women: A cross-sectional study in Karachi, Pakistan. BMJ Open 2021;11(4):1-10.
23. Biswas RK, Rahman N, Khanam R, *et al.* Double burden of underweight and overweight among women of reproductive age in Bangladesh. Public Health Nutr 2019;22(17):3163-3174.
24. Harismayanti dan Retni A. Faktor yang berhubungan dengan kejadian kekurangan energi kronis (KEK) pada ibu hamil di wilayah kerja Puskesmas Limboto. Zaitun Univ Muhammadiyah Gorontalo 2019;7(2):1-8.
25. Rachmawati NC, Dewi YLR, Widyaningsih V. Multilevel analysis on factors associated with occurrence chronic energy deficiency among pregnant women. J Matern Child Health 2019;4(6):474-485.
26. Minami M, J-P NA, Noguchi S, *et al.* Gestational weight gain mediates the effects of energy intake on birth weight among singleton pregnancies in the Japan environment and children's study. BMC Pregnancy Childbirth 2022;22(1):1-12.
27. J-P NA, Minami M, Eitoku M, *et al.* Lack of concern about body image and health during pregnancy linked to excessive gestational weight gain and small-for-gestational-age deliveries: The Japan environment and children's study. BMC Pregnancy Childbirth 2021;21(1):1-15.
28. Ługowska K, Kolanowski W. The nutritional behaviour of pregnant women in Poland. Int J Environ Res Public Health 2019;16(22).
29. Diemert A, Lezius S, Pagenkemper M, *et al.* Maternal nutrition, inadequate gestational weight gain and birth weight: Results from a prospective birth cohort. BMC Pregnancy Childbirth 2016;16(1):1-9.