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The correlation of nutrition knowledge with dietary diversity and nutritional status of pregnant women

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ABSTRAK

Latar Belakang: *Angka kematian pada ibu hamil mengalami peningkatan di Indonesia maupun di Provinsi Jawa Barat. Salah satu faktor yang berkontribusi terhadap fenomena ini adalah kejadian pada malnutrisi ibu atau kurang energi kronis yang berdampak buruk terhadap perkembangan.*
Tujuan: *Penelitian bertujuan untuk menganalisis hubungan pengetahuan gizi dengan keragaman pangan dan status gizi pada ibu hamil.*
Metode: *Penelitian ini menggunakan desain cross sectional dengan jumlah subjek sebesar 40 ibu hamil dengan teknik simple random sampling yang berada di wilayah kerja Puskesmas Cikembar Kabupaten Sukabumi. Pengumpulan data dilakukan pada tanggal 21 Februari hingga 3 Maret 2019. Variabel yang diteliti pada penelitian ini terdiri dari karakteristik subjek dan sosial ekonomi, antropometri ibu hamil, pengetahuan gizi, dan konsumsi pangan yang dinilai dengan menggunakan multiple 24 hour recall. Uji statistik yang digunakan meliputi uji deskriptif dan uji bivariat dengan menggunakan Uji Spearman.*
Hasil: *Prevalensi ibu hamil KEK sebesar 52.5%, tingkat pengetahuan gizi tergolong sedang (47.5%), dan konsumsi pangan yang tidak beragam (45.0%). Terdapatkorelasi yang signifikan antara pengetahuan gizi dan kualitas diet pada ibu yang tercermin pada keragaman konsumsi pangan (p= 0.032; r= 0.340). Terdapat pula korelasi yang signifikan antarapengetahuan gizi dengan indeks massa tubuh sebelum hamil (p= 0.032; r= 0.339), dan lingkar lengan atas (p= 0,016; r= 0,378)..*
Kesimpulan: *Peningkatan pengetahuan berhubungan dengan peningkatan keragaman pangan, indeks massa tubuh sebelum hamil, dan lingkar lengan atas. Hasil dari penelitian ini mengindikasikan bahwa pendidikan gizi dan kesehatan sangat penting dan masih perlu untuk ditingkatkan terutama pada calon ibu.*

KATA KUNCI*:* *ibu hamil; keragaman pangan; pengetahuan gizi; sosial ekonomi; status gizi*

ABSTRACT

Background: *The mortality rate among pregnant women has witnessed an escalation in both Indonesia and West Java. One contributing factor to this phenomenon is maternal malnutrition or chronic energy deficiency, exerting detrimental effects on both the developing fetus and the expectant mother.*

Objectives: *This study examined the correlation of nutrition knowledge, dietary diversity, and nutritional status of pregnant women.*

Methods: *This study used a cross-sectional design with 40 pregnant women as subjects using a simple random sampling technique in the working area of the Cikembar Community Health Center, Sukabumi Regency. Data collection was carried out from February 21 to March 3, 2019. The variables studied in this study consisted of subject and socio-economic characteristics, anthropometry of pregnant women, nutritional knowledge, and food consumption, which were assessed using multiple 24-hour recalls. The statistical tests used include descriptive and bivariate tests using the Spearman Test.*

Results: *The prevalence of CED pregnant women was 52.5%, the level of nutritional knowledge was moderate (47.5%), and food consumption was not diverse (45.0%). There is a significant correlation between nutritional knowledge and diet quality in mothers, reflected in the diversity of food consumption (p= 0.032; r= 0.340). There was also a significant correlation between nutritional knowledge, BMI before pregnancy (p= 0.032; r= 0.339), and MUAC (p= 0.016; r= 0.378).*

Conclusions: *Enhanced nutrition knowledge was associated with improved dietary diversity, BMI before pregnancy, and MUAC. These outcomes suggest that nutrition and health education pertaining to pregnancy are crucial for prospective mothers to prioritize and enhance.*

KEYWORD*:* *dietary diversity; nutrition knowledge; nutritional status; pregnant women; socioeconomic*

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INTRODUCTION

Nutrition plays a pivotal role in the human life cycle, contributing significantly to the attainment of national development objectives by reducing the prevalence of undernourished children and alleviating Chronic Energy Deficiency (CED) in pregnant women, thereby enhancing the quality of human resources. Globally, the primary concern remains the incidence of maternal mortality. Data from the 2021 Indonesia Health Profile reveals a significant rise in the number of maternal deaths in Indonesia, increasing from 4.627 cases in 2020 to 7.389 cases in 2021, marking an increase of 2.762 cases. Similarly, maternal mortality cases in West Java Province also experienced an increase, with a rise of 459 cases from 745 cases in 2020 to 1.204 cases in 2021 (1). Moreover, pregnant women who endure chronic malnutrition constitute a risk factor for maternal mortality, a phenomenon that remains prevalent in developing countries such as Bangladesh, India, Indonesia, Myanmar, Nepal, and others (2,3). According to the data from the 2013 and 2018 Basic Health Research, the prevalence of CED among pregnant women decreased from 24.2% in 2013 to 17.3% in 2018. This demonstrates a declining trend in the prevalence of pregnant women experiencing CED, with a decrease of 6.9% over the past five years (4,5). The 2015-2030 Sustainable Development Goals (SDGs) aim to reduce the prevalence of CED in pregnant women to 5%. However, the data from the Cikembar Health Center in 2017 indicates a prevalence of 8% among pregnant women (6).

CED is a condition that afflicts individuals who undergo prolonged malnutrition, and it is characterized by a Middle Upper Arm

Circumference (MUAC) measuring less than 23.5 cm (7). According to the ACC/SCN Administrative Committee on Coordination ACC)/Sub-Committee on Nutrition (SCN) framework, the direct causal factors contributing to the occurrence of CED in pregnant women include inadequate food consumption, particularly insufficient energy and protein intake, alongside a medical history that triggers mechanisms leading to the depletion of nutrient reserves in the mother's body. Furthermore, the indirect factors contributing to CED in pregnant women encompass insufficient food availability to meet their nutritional requirements, parenting styles, environmental health conditions, and limited access to healthcare services (8). The consequences of CED in pregnant women include the occurrence of anemia, bleeding, weakened immune systems, reduced weight gain, extended labor duration, and an increased likelihood of infants being born with low birth weight (9–12). The maternal nutritional status before pregnancy is categorized as underweight. Consequently, the total weight gain during pregnancy should be higher, as there is an increased risk of the baby being born with low birth weight (13,14).

Dietary diversity among pregnant women is of paramount importance to consider, given that it directly impacts their nutritional status. Pregnant women who consume a diverse range of foods tend to have a higher nutritional status. Nutritional status before pregnancy also requires consideration, as it will later be linked to weight gain (15). Consumption of a diverse array of foods can provide various nutrients required by the body, thus having the potential to fulfill the requirements for both macro and micronutrients, in contrast to individuals who consume single or non-varied foods (16–18). Furthermore, a relatively high-quality diet can also contribute to increased maternal weight gain, a factor of utmost importance for the health of both the mother and the fetus in the production of healthy and normal babies (19).

Several studies conducted have demonstrated that family socioeconomic characteristics, such as age, occupation, education level, and family income, are associated with the incidence of CED and the dietary diversity (20–25). Several studies conducted have demonstrated that family socioeconomic characteristics, such as age, occupation, education level, and family income, are associated with the incidence of CED and the dietary diversity (24,26–28) and nutritional status of pregnant women (29–31). Low nutrition knowledge among pregnant women is also linked to sociocultural beliefs and food taboos, which exert a significant influence on their eating habits (24,27). Nevertheless, further research is warranted to investigate the correlation of nutritional knowledge, dietary diversity, and nutritional status, considering BMI before pregnancy and MUAC as essential parameters. This is because the research topic remains relatively limited; therefore, research can offer valuable insights for government consideration when planning and developing programs aimed at improving the nutrition of pregnant women. Therefore, this study aims to analyze the correlation of nutrition knowledge, dietary diversity, and the nutritional status of pregnant women.

MATERIALS AND METHODS

This research employs a cross-sectional study design using an observational approach, conducted at the Cikembar Health Center in Sukabumi Regency from February 21st to March 3rd, 2019. This research has undergone and received approval from the Commission on Research Ethics Involving Human Subjects at IPB University, with the reference number 154/IT3.KEPSM IPB/SK/2019.

Population of this study comprised all pregnant women attending the Cikembar Health Center. Subjects in this study included pregnant women who experienced chronic energy deficiency and those with normal nutritional status. Subject selection in this study employed purposive sampling based on specified inclusion and exclusion criteria. Inclusion criteria for this study encompassed the following: pregnancy in the second and third trimesters, absence of a history of chronic disease, and mothers who attended maternal and child health services. Conversely, the exclusion criteria for this study encompassed the following: relocating to a different address, and being unwilling to participate in interviews. Pregnant women in the first trimester were not included in this study due to the common

occurrence of morning sickness, characterized by nausea and vomiting caused by hormonal changes, such as estrogen, progesterone, and human chorionic gonadotropin (32–35 Subjects in this study comprised 40 pregnant women using a *simple random sampling technique*. Data collected in this study included both primary and secondary data. Primary data collection encompassed socioeconomic characteristics of the subjects (age, education level, occupation, husband's age, husband's education level, husband's occupation, and family income), anthropometric measurements of pregnant women (MUAC), knowledge about nutrition and health, as well as maternal food consumption for 24 hours on weekdays. Meanwhile, the secondary data included maternal anthropometric measurements taken before pregnancy, which encompassed their weight and height.

Data for this study were collected through the completion of questionnaires by the subjects and interviews conducted by the enumerator team. In this study, the assessment of food consumption utilized the single 24-hour recall method, which was subsequently employed to evaluate the diversity of food consumption among pregnant women in accordance with the guidelines outlined by the Food and Agriculture Organization of the United Nations in 2021. These guidelines categorize food into ten groups, namely: 1) Grains, white roots, and tubers, 2) Pulses (beans, peas, and lentils), 3) Nuts and seeds, 4) Milk and milk products, 5) Meat, poultry, and fish, 6) Eggs, 7) Dark green leafy vegetables, 8) Other vitamin A-rich fruits and vegetables, 9) Other vegetables, and 10) Other fruits.

The collected data is subsequently input, edited, and cleaned using statistics software. The age categories for the subjects are divided into two groups: <20 years and ≥35 years, and 21-34 years. Similarly, the husband's age is categorized into three groups: <20 years, 20-35 years, and >35 years. 23 The variables for the subjects' and husbands' educational levels were categorized into five groups: no formal education, elementary school, junior high school, senior high school, and higher education (36). Conversely, the subjects' employment status was categorized into two groups: employed and unemployed (23). The family income level is defined based on the 2019 regional minimum wage for Sukabumi Regency, consisting of incomes less than Rp. 2.791.016 and equal to or greater than Rp. 2.791.016. (37). The assessment of nutritional status in the study was calculated based on both BMI before pregnancy and MUAC. Categories of BMI consist of Underweight (<18.5 kg/m2), Normal weight (18.5-24.9 kg/m2), Overweight (25.0–29.9 kg/m2), and Obese (> 30.0 kg/m2) (15). In contrast, the MUAC category was divided into two groups. Specifically, a mother was considered to have experienced CED (malnutrition) if her MUAC was <23.5 cm, and she was classified as having a normal nutritional status if her MUAC was ≥23.5 cm (7).

Data processing for assessing the diversity of food and beverages consumed by pregnant women in the preceding 24 hours will be carried out based on ten food groups. Pregnant women will be categorized as having consumed a particular food group if the weight of the food is greater than or equal to 15 gr, whereas they will be classified as not having consumed it if the weight is less than 15 gr. Pregnant women who consume less than 15 gr of food from a particular food group are not considered to have consumed that food group. Pregnant women who consume food from at least 5 out of the 10 food groups are categorized as having a diverse food intake (38). Data on nutrition and health knowledge consists of 20 questions related to nutritional status and its impacts, sources of nutrients in food, eating patterns in pregnant women, and health in pregnant women, filled in with questions by the subject and accompanied by researchers through a questionnaire. Data on maternal nutritional knowledge was coded based on the mother's answers to each question in the questionnaire. The correct answer score is 5, while the incorrect answer score is 0. Nutrition knowledge was assessed using a valid and reliable questionnaire with a Cronbach's alpha value of 0.764. The statistical analysis employed in this research consists of univariate or descriptive tests to examine the distribution of subjects based on subject characteristics, socioeconomic status, nutritional status, and nutrition knowledge. Additionally, a bivariate analysis, specifically the Spearman test, was used to analyze the correlation of subject characteristics and socioeconomic status with nutritional status, as

well as the correlation of nutrition knowledge, dietary diversity, and nutritional status in pregnant women.

RESULTS AND DISCUSSIONS

Table 1 reveals that the majority of the subjects fall within the age range of 20-35 years, have an elementary school level education or equivalent, and are employed. The distribution of husbands employed in this study consisted of state civil servants (17.5%), self-employed workers (45.0%), and employees working in the service sector (37.5%). Meanwhile, the majority of the subjects' husbands are aged 19-29 years, have completed senior high school education, and are all employed. On the other hand, the majority of them have a family income exceeding the Regional Minimum Wage for Sukabumi Regency in 2019. The characteristics and socioeconomic information of the pregnant women subjects are presented in **Table 1**.

Table 2 indicates that most pregnant women possess a reasonably adequate level of nutrition knowledge, while others are classified as moderate. Apart from that, most of the food pregnant women consume is classified as diverse, but it is still found that 45% of pregnant women consume various foods

Table 1. Characteristic of participants

Characteristic of subjects	n	%
Mother Age		
<20 years dan >35 years	10	25.0
20-35 years	30	75.0
Mother Education Level		
No Education	7	17.5
Elementary School	18	45.0
Junior High School	12	30.0
Senior High School	3	7.5
Colleges/University	0	0.0
Mother Occupational Status		
Did Not Work	32	80.0
Work	8	20.0
Husband Age		
19-29 years	24	60.0
30-49 years	16	40.0
Husband Education Level		
No Education	1	2.5
Elementary School	6	15.0
Junior High School	10	25.0
Senior High School	23	57.5
Colleges/University	0	0.0
Husband Occupational Status		
Did Not Work	0	0.0
Work	40	100
Family Income (Rupiah/month)		
Under The Minimum Wage	13	32.5
Above and Equal to The Minimum Wage	27	67.5

The distribution of pregnant women based on their BMI before pregnancy primarily fell within the normal category, although some mothers were classified as underweight. Conversely, when assessing the nutritional status of pregnant women based on MUAC, the majority were categorized as experiencing CED. The prevalence of CED in pregnant women in this study was classified as more significant than the prevalence of CED in pregnant women in the Cikembar

Community Health Center working area in 2019, which was 3.9%. However, the prevalence of pregnant women experiencing CED based on the 2018 Basic Health Research in Indonesia was 17.3%, West Java Province was 14.08%, and Sukabumi Regency was 24.29% (5). The percentage of CED pregnant women in 2018-2023 in Indonesia (16.9%) and West Java Province (11.6%) tends to increase based on the 2023 Indonesian health survey (39). This shows that the prevalence rate of CED in pregnant women is still relatively high when compared with the national government targets in 2018 (19.7%), 2019 (18.2%), and 2023 (11.5%) stated in the 2015-2019 National Middle Ages Development Plan. and 2019-2024 (40–42). Therefore, nutritional problems in pregnant women need to be the focus of attention for the government at the national, provincial, district, and sub-district levels, so efforts need to be made to accelerate the reduction of nutritional problems in pregnant women.

Table 2. Distribution of subjects based on nutrition knowledge, nutritional status, and dietary diversity

Variables	n	%
Nutrition Knowledge [a]		
Less	13	32.5
Moderate	19	47.5
Good	8	20.0
Dietary diversity		
Diverse Food	22	55.0
Not Diverse Food	18	45.0
Body Mass Index Before Pregnancy [b]		
Underweight	12	30.0
Normal	24	60.0
Overweight	4	10.0
Obese	0	0.0
Middle Upper Arm Circumference [a]		
Chronic Energy Deficiency	21	52.5
Normal	19	47.5

Source: [a]Primary Data (2019)
[b]Secondary Data

Figure 1. shows that pregnant women who are classified as having normal nutritional status have a percentage of pregnant women's food consumption in the groups of nuts, nuts and seeds, milk and dairy products, meat, poultry and fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables and other fruits which are classified as higher than those of pregnant women who are classified as having chronic energy deficiency. The more food groups pregnant women consume, the more diverse food consumption can help maintain and improve nutritional status.

Pregnant women with moderate and good nutritional knowledge consume higher levels of pulses (42.1%, 75.0%), nuts and seeds (15.8%, 0.0%), milk and dairy products (57.9%, 50.0%), other vitamin A-rich fruits and vegetables (42,1%, 25.0%), and other fruits (31.6%, 87.5%) than pregnant women with a low level of nutritional knowledge. However, this research found that the tendency to consume meat, poultry, fish (76.9%), eggs (61.5%), and dark green leafy vegetable (61.5%) food groups was higher in pregnant women with a relatively low level of nutritional knowledge.

All pregnant women consume food groups including grains, white roots, and tubers, as well as plantains. Nevertheless, this study identified that the consumption of other food groups remains relatively low and requires improvement. These food groups include pulses, eggs, dark green leafy vegetables, nuts and seeds, milk and milk products, meat, poultry, fish, and other vitamin-rich foods. These include other vitamin A-rich fruits and vegetables, other vegetables, and other fruits, where the percentage of pregnant women consuming these food groups remains below 50%. Furthermore, over half of the pregnant women in the study already have a diverse food

intake. Nonetheless, it is noteworthy that 45% of mothers do not have a varied food intake, indicating a need for improvement, particularly in the food groups of nuts and seeds, other vitamin A-rich fruits and vegetables, other vegetables, and other fruits.

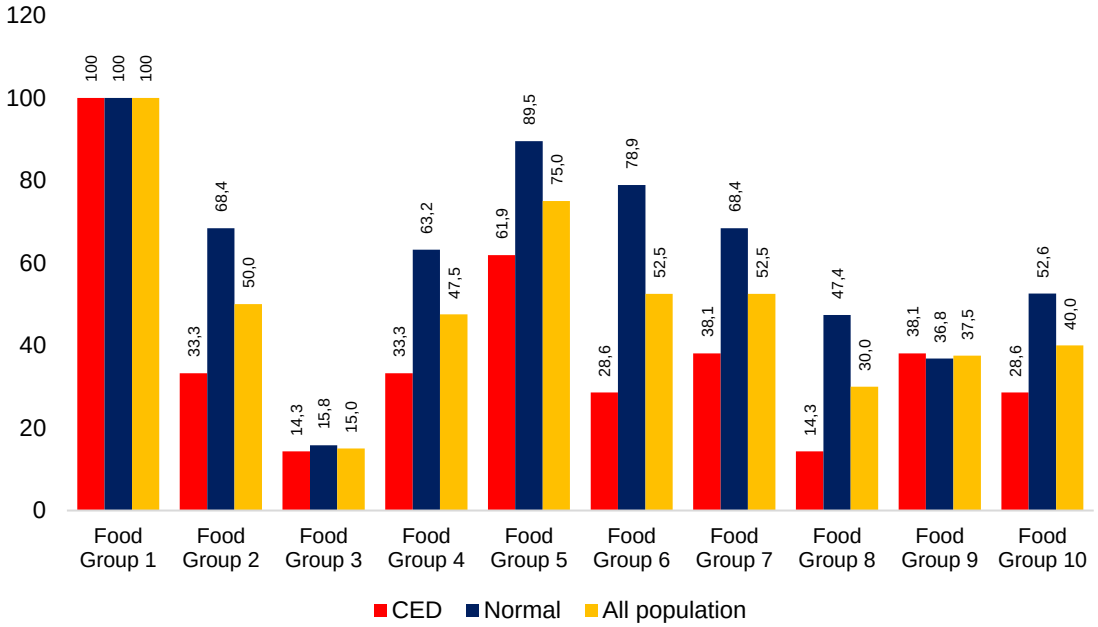

Figure 1. Distribution of food group consumption (%) and the diversity of food consumption of pregnant women

Note:
Food Group 1=grains, white roots and tubers, and plantains, Food Group 2=pulses (beans, peas, and lentils), Food Group 3= nuts and seeds, Food Group 4= milk and milk products, Food Group 5=meat, poultry, and fish, Food Group 6= eggs, Food Group 7= dark green leafy vegetables, Food Group 8= other vitamin A-rich fruits and vegetables, Food Group 9= other vegetables, and Food Group 10= other fruits.
Source: Primary Data (2019)

Table 3 reveals that maternal age and family income exhibit a significant correlation with maternal nutritional status, as indicated by body mass index and middle upper arm circumference ($p < 0.05$). These two variables exhibit a positive but relatively weak correlation, with the exception of the correlation between age and body mass index before pregnancy, which is very strong (43). This implies that as age increases, the mother's BMI before pregnancy and MUAC values also increase. Moreover, as the family income level rises, the mother's BMI before pregnancy and MUAC values also increase.

The outcomes of this study indicate that 25% of pregnant women fall into the age categories of less than 20 years and more than 35 years. This is associated with the mother's preparedness from biological, emotional, and mental standpoints. Additionally, the results of this study also reveal a significant correlation between maternal age and nutritional status based on MUAC and BMI before pregnancy, consistent with outcomes from several previous studies (40–44). The ideal and safe reproductive age during pregnancy is classified as 20-35 years. Therefore, mothers under the age of 20 years may exhibit an immature level of readiness, leading to a lack of knowledge about nutrition and health, as well as a lower awareness of pregnancy-related matters. Meeting nutritional needs during pregnancy is essential. Mothers over 35 years of age are associated with decreased organ function and a weakened immune system, making them more susceptible to various diseases and increasing their risk of maternal mortality (45–47). This is supported by the cross-tabulation analysis, which indicates that the majority of mothers aged 20-35 years possess a moderate to high level of

knowledge, in contrast to mothers aged less than 20 years and more than 35 years.

The age of the husband was found to be insignificant correlation to the mother's nutritional status. The husband's age can influence the type and pattern of food available in the household. This is because the husband's younger age tends not to have a steady income so that it will affect the diversity of food consumption of pregnant women, impacting nutritional status. Apart from that, the husband's age will also be related to experiences that will support the wife during pregnancy, which influences stress, psychological well-being, eating patterns, and nutritional status (52,53). The different test analyses also showed no significant difference in the husband's age distribution on the mother's nutritional status before and during pregnancy ($p > 0.05$).

The level of education is crucial and correlates with an individual's capacity to comprehend information, subsequently leading to an enhanced understanding of topics related to nutrition and health (49). The correlation between maternal education level and nutritional status is not significant, which aligns with outcomes from several previous studies (23,50,51). Higher education often fosters an awareness of the significance of fulfilling nutritional requirements during pregnancy and facilitates better decision-making regarding the selection of foods recommended and not recommended during pregnancy (40,48). Several factors, including access to information, awareness of the significance of nutrition, and improved decision-making, can elucidate the connection between education level and nutrition knowledge. Mothers with a higher level of education generally have improved access to sources of information related to nutrition and health (52). The subject and her husband both have an elementary school education, while the husband has completed high school. According to cross-tabulation analysis, mothers with a high school education and husbands with an education level of junior high school or higher tend to have income levels exceeding the regional minimum wage. This also illustrates that the level of education is correlated with socioeconomic status or family income (53).

Family income is a factor that influences the fulfillment of household needs, particularly in meeting the family's dietary requirements. The outcomes of this research demonstrate a significant correlation between income and nutrition knowledge as well as nutritional status in mothers, which aligns with several previous studies (54–56). This illustrates that households with favorable socioeconomic conditions (earning above the regional minimum wage) are capable of satisfying various household food requirements. Simultaneously, families with relatively low incomes may encounter obstacles or difficulties in accessing or affording nutritious and diverse foods. The higher the household income, the greater the opportunity to purchase a wider variety of staple foods, fruits, vegetables, and other food ingredients (57,58). The results of the cross-tabulation analysis also demonstrate that mothers with income levels above the regional minimum wage tend to have a BMI before pregnancy (75%) and MUAC (78.9%) classified as within the normal range. Additionally, a low socioeconomic status can also impact household food security, leading to suboptimal conditions in terms of food availability, access, and utilization. This can result in inadequate food consumption that fails to meet quantity, quality, and nutritional needs, both before and during pregnancy, as evidenced by lower BMI and MUAC levels among women (11,59–62).

Education level can indicate a person's level of formal education and is closely associated with their nutritional status. The results of this study do not indicate a significant correlation with nutritional status, which is consistent with outcomes from several previous studies (52,63,64). This is because, as revealed by cross-tabulation analysis, mothers and husbands with low educational levels tend to have a higher percentage of mothers with a BMI before pregnancy and MUAC classified as underweight and normal. Moreover, there is no significant difference between the education levels of mothers and husbands regarding the body mass index and MUAC ($p > 0.05$). Nonetheless, the level of education plays an important role. Education level will influence a person's ability to receive and comprehend information that can be utilized as a resource in the care of pregnant women. Therefore, the higher the education of both the mother and husband, the better the

nutritional status of pregnant women will be, as reflected in the availability of sufficient and high-quality food (65,66).

There is no significant correlation between the employment status of the mother and husband and the mother's nutritional status, as indicated by BMI before pregnancy and MUAC. This outcome is consistent with several previous studies (51,64,67). This is because mothers, regardless of their employment status or being homemakers, exhibit a percentage distribution of BMI and MUAC that falls within the low or usual range. There is no significant difference between the nutritional status of mothers, both before and during pregnancy, and the employment status of mothers and husbands ($p > 0.05$). Nonetheless, employment plays a crucial role in defining and maintaining the standard of living, which in turn influences the household's socioeconomic status. Households with relatively low incomes will experience challenges in meeting their household food requirements (68,69). Several previous studies have indicated that households of pregnant women with income levels classified as less than or below the regional minimum wage are more likely to experience malnutrition compared to households of pregnant women with income levels classified as good or exceeding the minimum wage (70,71).

Table 4 demonstrates that there is a significant correlation of nutrition knowledge and dietary diversityand the nutritional status of pregnant women, as indicated by BMI before pregnancy and MUAC ($p < 0.05$). These three variables depict a positive correlation of nutrition knowledge and dietary diversity f, nutrition knowledge and BMI before pregnancy, as well as nutrition knowledge and middle upper arm circumference, albeit with relatively low strength in the relationship (43). This suggests that as the mother's nutrition knowledge improves, there is a tendency for her to consume a more diverse range of foods, and her nutritional status is also likely to be better, as evidenced by the normal classification of body mass index and middle upper arm circumference values.

A relatively low level of education makes it difficult to get a good job and will support the family's income. Low income will cause low access or purchasing power to food in terms of quality and quantity (77). Education will influence the level of knowledge in food processing and selecting food ingredients and menus, so people with low education have beliefs that are difficult to change. The level of education can influence the nutritional knowledge of pregnant women because a better level of education can make it easier to understand nutrition-related information and will have an effect on increasing awareness about good nutrition during pregnancy (78). Women with more education tend to have better nutritional knowledge, which may influence food choices and nutritional practices during pregnancy (79–81). Therefore, a higher level of education will also influence the ability to receive information obtained from various media and put it into practice in everyday life.

Knowledge results from understanding and conceptualizing a specific subject, reflecting the human inclination for curiosity, the pursuit of rationale, and the organization of experiences (72). The outcomes of this research indicate a significant correlation between nutrition knowledge and health concerning the quality of the mother's diet, as demonstrated by the diversity of food consumption. This observation aligns with several previously conducted studies (73–78). Mothers with a relatively high level of nutritional and health knowledge have a 3.2 times greater likelihood of consuming a variety of foods compared to mothers with a relatively low level of nutritional and health knowledge (79). This is because relatively good maternal nutrition knowledge will enhance dietary practices that, in turn, contribute to achieving better dietary diversity. The formal education level of both mothers and husbands also affects their knowledge of nutrition and health. A higher level of education leads to a better understanding of information pertaining to nutrition and health, which is acquired through antenatal care services and various other information sources, as well as a higher socioeconomic status (24,73,80,81). This phenomenon was also observed in this research: the higher the education level of both husbands and wives, along with the household income level, the more likely they were to possess moderate and reasonable levels of nutrition knowledge. Mothers with a relatively high level of nutrition knowledge also possess a good understanding of

Table 3. Analysis of the correlation of subjects characteristics and socioeconomic with nutritional status of pregnant women

Variables	BMI Before Pregnancy						r	p	MUAC During Pregnancy				r	p
	Underweight		Normal		Overweight and obese				CED		Normal			
	n	%	n	%	n	%			n	%	n	%		
Mother Age														
<20 years dan >35 years	6	50.0	3	12.5	1	25.0	0.847	0.039*	6	28.6	4	21.1	0.463	0.003*
20-35 years	6	50.0	21	87,5	3	75.0			15	71.4	15	78.9		
Mother Education Level														
No Education	0	0.0	0	0.0	0	0.0			0	0.0	0	0.0		
Elementary School	2	16.7	4	16.7	1	25.0	0.053	0.745	4	19.0	3	15.8	0.092	0.574
Junior High School	7	58.3	9	37.5	2	50.0			9	42.9	9	47.4		
Senior High School	2	16.7	9	37.5	1	25.0			7	33.3	5	26.3		
Colleges/University	1	8.3	2	8.3	0	0.0			1	4.8	2	10.5		
Mother Occupational Status														
Did Not Work	10	83.3	18	75.0	4	100.0	0.043	0.791	16	76.2	16	84.2	-	0.740
Work	2	16.7	6	25.0	0	0.0			5	23.8	3	15.8	0.054	
Husband Age														
19-29 years	11	57.9	13	76.4	0	0.0	-0.002	0.988	20	71.4	4	33.3	0.070	0.667
30-49 years	8	42.1	4	23.6	4	100.0			8	28.6	8	66.7		
Husband Education Level														
No Education	1	8.3	0	0.0	0	0.0			1	0.0	0	0.0		
Elementary School	3	25.0	2	8.3	1	25.0	0.117	0.472	5	4.8	1	5.3	0.297	0.063
Junior High School	3	25.0	6	25.0	1	25.0			5	23.8	5	26.3		
Senior High School	5	41.7	16	66.7	2	50.0			10	23.8	13	68.4		
Colleges/University	0	0.0	0	0.0	0	0.0			0	47.6	0	0.0		
Husband Occupational Status														
Did Not Work	0	0.0	0	0.0	0	0.0	0.047	0.775	0	0.0	0	0.0	-	0.876
Work	12	100.0	24	100.0	4	100.0			12	100.0	19	0.0	0.026	
Family Income														
Under The Minimum Wage	7	58.3	6	25.0	0	0.0	0.347	0.028*	9	42.9	4	21.1	0.354	0.025*
Above and Equal to The Minimum Wage	5	41.7	18	75.0	4	100.0			13	57.1	15	78.9		

Source: Primary Data (2019)

**) Spearman test, there is significant correlation (p<0.05)*

Table 4. Analysis of the correlation of nutrition knowledge with dietary diversity and nutritional status of pregnant women

Variables	Dietary Diversity						BMI Before Pregnancy							MUAC					
	Diverse Food		Not Diverse Food		r	p	Underweight		Normal		Overweight and obese		r	p	CED		Normal		r	p
	n	%	n	%			n	%	n	%	n	%			n	%	n	%		
Nutritional Knowledge																				
Less	4	18.2	9	50.0	0.340	0.032*	6	50.0	5	20.8	2	50.0	0.339	0.032*	10	47.6	3	15.8	0.378	0.016*
Moderate	12	54.5	7	38.9			5	41.7	12	50.0	2	50.0			9	42.9	10	52.6		
Good	6	27.3	2	11.1			1	8.3	7	29.2	0	0.0			2	9.5	6	31.6		

Source: Primary Data (2019)

**) Spearman test, there is significant correlation (p<0.05)*

the importance of consuming a variety of foods. This allows them to ensure that the various nutrients they consume, including protein, fat, carbohydrates, vitamins, and minerals, play a crucial role in supporting the growth and development of the fetus and preparing for pregnancy conditions (75,78).

Generally, the relationship between household income and dietary diversity is positive, meaning that the higher the household or family income, the more diverse the food consumption. Income classified as higher allows households to make it easier to access food, including purchasing various types of food. In contrast, households with relatively low incomes will experience limitations in purchasing food (92). The wealth or socio-economic index, reflected in income, is related to the cumulative standard of living in a household and the fulfillment of food diversity, which is very important to pay attention to, so increasing income significantly influences food consumption. This is because the wealth index is closely related to the level of family income and family financial constraints, limiting families' ability to provide diverse, nutritious, balanced, and safe food (93–96). Therefore, household incomes classified as better can consume food that is good in quality and quantity, which is expected to impact the optimal nutritional and health status of pregnant women. The outcomes of this study reveal a significant correlation between maternal knowledge of nutrition and health and nutritional status, as indicated by BMI before pregnancy and MUAC. These results align with several previous studies (67,82–85). Cross-tabulation analysis indicates that mothers with moderate and good nutrition knowledge tend to have BMI before pregnancy and MUAC values classified as within the normal range. This is because nutrition knowledge influences attitudes and practices related to food consumption. Mothers with good nutrition knowledge can discern healthy and nutritious foods and plan diverse menus with a variety of food ingredients (86). A person will be motivated to adopt healthy behaviors, including consuming foods classified as nutritious, when they possess good knowledge, attitudes, and skills in this regard. Therefore, health behavior is sustained over an extended period when it is grounded in knowledge, attitudes, and practices that the individual is conscious of, thereby contributing to an enhanced health status and well-being (85).
Relatively good knowledge related to nutrition and health will also influence the mother's capacity to gain weight during pregnancy. This is supported by previous research, which indicates that mothers with relatively low nutrition knowledge tend to gain weight that does not adhere to recommendation (87). Furthermore, BMI and MUAC are closely related, as when a mother's BMI before pregnancy is relatively low, she has a greater likelihood of experiencing chronic energy deficiency, characterized by an MUAC of less than 23.5 cm and decreasing further. The higher the BMI before pregnancy, the greater the weight gain the mother must aim for in each trimester (15).

The limitations of this research include the use of a cross-sectional study design, which does not allow for the description of causal relationships, and the limited number of variables studied, which prevents a comprehensive examination of factors related to nutritional status in pregnant women.

CONCLUSIONS AND RECOMMENDATIONS

There is a positive and significant correlation of nutrition knowledge and dietary diversity, BMI before pregnancy, and MUAC in pregnant women. The Indonesian government and Sukabumi Regency officials need to implement development programs related to nutrition, particularly in the realm of nutrition education. These programs can commence with prospective brides and married couples, with the hope that they can enhance their knowledge, dietary diversity, and nutritional status in preparation for and during pregnancy.

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