

EFFECT OF NUTRITIONAL STATUS AND PROTEIN INTAKE ON LEVELS OF SERUM ALBUMIN IN PREGNANT WOMEN IN SELUMA DISTRICT

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Abstract. The mother's nutritional status during pregnancy affects newborn's health. Inadequate dietary intake affects several biomarkers that may influence fetal growth. This study aimed to examine the relationship between nutritional status and levels of serum albumin in pregnant women residing in the Seluma Regency. This cross-sectional study included 130 pregnant women in their second and third trimesters. Sample characteristics were obtained using a questionnaire, and nutritional status data were obtained by measuring the circumference of the upper arm and grouping the nutritional status into chronic energy deficiency (CED) and non-CED, protein intake was measured using the 3x24 hour food recall method then grouped into low intake and adequate intake. Measurement of serum albumin levels was carried out using the colorimetric method. All data were analyzed with an independent t-test. Based on the measurement of nutritional status, it was found that 27.7% of pregnant women experienced CED and 85.4% of pregnant women have low protein intake. The result showed that the average albumin serum level in pregnant women with CED was lower than in pregnant women without CED (31.217 ± 5.98 g/dl vs 34.189 ± 3.97 g/dl, $p=0.002$). In summary, nutritional status affects levels of

albumin serum in pregnant women in the Seluma Region. Monitoring nutritional status and protein intake during pregnancy is essential for determine the health of the mother and baby during pregnancy.

Keywords: chronic energy deficiency, protein intake, albumin levels, nutritional status, pregnant women

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INTRODUCTION

Nutritional status is crucial for mothers in preparing for their pregnancy. The mother's nutritional status before and during pregnancy will influence fetal development. Pre-pregnancy chronic energy deficiency (CED) increases the risk of stillbirth, premature birth, small for gestational age (SGA), and low birth weight (Triunfo and Lanzone, 2015; Christian and Stewart, 2010; Sharma and Mishra, 2014). The incidence of CED remains relatively high in Indonesia. In Indonesia, the prevalence of CED in 2018 was 17.3% (MOH RI, 2019b), where this figure was below the national target (19.7%) (MOH RI, 2015). However, the 2018, basic health research revealed that 31.8% of women of reproductive age experienced CED, with the highest prevalence among fertile women aged 15 to 19; 33.5% in pregnant women and 36.3% in non-pregnant women (MOH RI, 2019b). Children born to malnourished mothers tend to be malnourished, leading to poor cognitive development, short stature, and a higher risk of morbidity and mortality (Fan *et al*, 2016; Huang *et al*, 2014).

CED is caused by a prolonged deficiency in energy and protein intake. Protein intake during pregnancy is essential for organ deposition in the mother and tissue formation in the fetus, particularly in the third trimester. Low protein intake during pregnancy is linked to negative outcomes for the pregnant woman and the developing fetus (Maslova *et al*, 2014; Switkowski *et*

al, 2016). Low protein intake results in low total protein levels in the blood. Albumin comprises sixty percent (60%) of the total protein content. Low blood albumin levels are typically caused by low protein levels and protein intake (Soeters *et al*, 2019).

Pregnant women with CED are more prevalent in rural areas (19.3%) than in urban areas (15.3%) (MOH RI, 2019b). In Bengkulu Province, the prevalence of CED among pregnant women is 12.14%, with Seluma District having the highest rate of CED (23.75%) (MOH RI, 2019a). This study aimed to analyze the effect of nutritional status on albumin serum levels in pregnant women residing in the Seluma Regency. Thus, the health status of pregnant women in Seluma Regency can be known and followed up immediately according to the results obtained.

MATERIALS AND METHODS

This study was a cross-sectional study held in Seluma District with a sample of 130 pregnant women in the 2nd and 3rd trimesters. Random sampling was conducted from 4 public health centers: Tais City Health Center, Talang Tinggi Health Center, Rimbo Kedui Health Center, and Masmambang Health Center. Study subjects' characteristics were obtained through questionnaires, such as mother's age based on Ministry of Health Republic of Indonesia (MOH RI, 2009) grouped into: at risk (<20 and ≥35 years old) and no risk (≥20 to <35 years old); gestation age (2nd trimester and 3rd trimester); education (low level if no school, elementary school and junior high school and high level if high school and college); working status (unemployed, employed); number of family members (≤4 people and >4 people); economic status (low level if receiving regional minimum pay and high level if receiving equal to or greater than regional minimum pay). Nutritional status data were obtained by measuring the maternal mid-upper arm circumference (MUAC) and grouping the nutritional status into CED (MUAC <23.5 cm) and non-CED (MUAC ≥23.5 cm). The protein intake was measured using the 3x24 hour food recall method and grouped into low

intake (<70 grams for 2nd Trimester and <90 grams for 3rd Trimester) and adequate intake (≥70 grams for 2nd Trimester and ≥90 grams for 3rd Trimester) while levels of serum albumin were measured by colorimetric method (Albumin LiquiColor, Cat No. 15600; HUMAN Gesellschaft für Biochemica und Diagnostica mbH, Wiesbaden, Germany). The data obtained were then analyzed with Statistical Package for the Social Sciences (SPSS) version 22 (SPSS Inc, Chicago, IL) to find the difference in levels of serum albumin in pregnant women with CED and normal nutritional status.

This research has received an ethical approval from the Ethics Commission for Health Research Faculty of Public Health, Sriwijaya University No. 231 / UN9. FKM/TU. KKE/2022

RESULTS

The characteristics of research participants (Table 1) revealed that 80% of mothers were at the risky pregnancy age (<20 and ≥35 years old) and 56.9% were in the third trimester. The majority of mothers are highly educated (high school and college) (67.7%); only a small percentage are employed (23.1%); 53.8% are small families with fewer than four members; and the majority of mothers have low economic status (63.8%). Measuring nutritional status and protein intake revealed that 34.6% of mothers had CED, and the majority had a low protein intake (<70 grams for 2nd Trimester and <90 grams for 3rd Trimester).

Table 1
Characteristics of pregnant women in Seluma District (N = 130)

Characteristic	Frequency <i>n</i> (%)
Mother's age	
<20 and ≥35 years old (at risk)	26 (20.0)
≥20 to <35 years old (no risk)	104 (80.0)

Table 1 (cont)

Characteristic	Frequency <i>n</i> (%)
Gestation age	
2 nd trimester	56 (43.1)
3 rd trimester	74 (56.9)
Education*	
Low level	42 (32.3)
High level	88 (67.7)
Working Status	
Unemployed	100 (76.9)
Employed	30 (23.1)
Number of family members	
≤4 people	70 (53.8)
>4 people	60 (46.2)
Economic status [†]	
Low level	83 (63.8)
High level	47 (36.2)
Nutritional status	
CED	45 (34.6)
Non-CED	85 (65.4)
Protein intake [‡]	
Low intake	111 (85.4)
Adequate intake	19 (14.6)

*Low level education: no school: elementary school, junior high school; High level education: high school, college

[†]Low level economic status: receiving regional minimum pay; High level economic status: receiving equal to or greater than regional minimum pay

[‡]Low protein intake: <70 grams for 2nd Trimester and <90 grams for 3rd Trimester; Adequate protein intake: ≥70 grams for 2nd Trimester and ≥90 grams for 3rd Trimester

CED: chronic energy deficiency

Serum albumin measurements revealed that pregnant women who experienced CED had lower levels of serum albumin than pregnant women who did not experience CED. However, there is no statistically significant difference ($p = 0.779$). This indicates that nutritional status has no effect on levels of serum albumin in pregnant women (Table 2).

Measuring levels of serum albumin revealed that mothers with low protein intake had lower levels of serum albumin than mothers with adequate protein intake. The statistical tests revealed a statistically significant difference ($p = 0.002$). This demonstrates that protein intake influences serum albumin levels in pregnant women (Table 3).

DISCUSSION

The results of this study showed that 34.6% of pregnant women experienced CED, and 85.4% of pregnant women had low protein intake. Low protein intake among pregnant women is influenced by numerous factors, including low socioeconomic status (Li *et al*, 2019). The majority of mothers in this study (63.8%) have a low socioeconomic status, which affects the availability of food, including protein sources, in their households.

Table 2

Comparison of serum albumin levels between pregnant women with chronic energy deficiency and without CED

Nutritional status	Number of pregnant women	Serum albumin level Mean \pm SD (g/dl)	p -value
CED	45	3.169 \pm 1.136	0.779**
Non-CED	85	3.211 \pm 0.602	

**Independent t-test, significant at $p < 0.05$

CED: chronic energy deficiency; g/dl: grams per deciliter; SD: standard deviation

Table 3

Comparison of serum albumin levels between pregnant women with low protein intake and normal protein intake

Protein intake	Number of pregnant women	Serum albumin level Mean \pm SD (g/dl)	<i>p</i> -value
Low intake (<70 grams for 2 nd Trimester and <90 grams for 3 rd Trimester)	111	3.104 \pm 0.853	0.002
Adequate intake (≥ 70 grams for 2 nd Trimester and ≥ 90 grams for 3 rd Trimester)	19	3.736 \pm 0.203	

g/dl: grams per deciliter; SD: standard deviation

Household food security is a factor that influences the prevalence of CED in pregnant women (Ramadhani *et al*, 2021). This study's findings are consistent with those of Gomez-Cantarino *et al* (2020) who reported a decrease in levels of serum albumin among pregnant women in the second and third trimesters with varying socioeconomic status. During the gestation period, protein adequacy is crucial, as protein is required for tissue synthesis in the mother's body and for supporting the growth and development of the fetus, which is increasing and peaking in the third trimester (Marangoni *et al*, 2016).

Albumin and total protein levels are biochemical markers that can be used to assess a person's nutritional status. Low protein levels are typically associated with low albumin levels due to insufficient protein intake and cause a poor quality of life (Soeters *et al*, 2019). During pregnancy, low albumin levels can also be caused by hemodilution or proteinuria in addition to inadequate protein intake. Low serum albumin levels can prevent maternal and infant mortality during the third trimester of pregnancy (Sufrin *et al*, 2015). There are three types of macronutrients: carbohydrates, fats, and proteins. Carbohydrates and fats are the primary sources of energy in the body, while proteins are used to form and repair damaged cells. Proteins

will be used when the consumption of carbohydrates and fats is insufficient to meet energy needs (Almatsier *et al*, 2011). Protein is also essential for iron metabolism within the body (Chen *et al*, 2006). Different proteins play different roles, for example, ligands and clathrins play a role in iron absorption, transferrin in iron transport, ferritin in iron storage, and globulin and myoglobin as oxygen carriers (Weinborn *et al*, 2015). Albumin is the main protein in human plasma, comprising about 60% of the total protein plasma. Approximately 40% of albumin is found in plasma, whereas the remaining 60% is found in the extracellular space. The liver produces approximately 12 grams of albumin per day, which accounts for 25% of the total synthesis of hepatic proteins and 50% of all proteins that the organ excretes (Levitt and Levitt, 2016). Several factors affect albumin synthesis, including nutrients, particularly amino acids, hormones, and the presence of disease (Levitt and Levitt, 2016). Malnutrition can result in abnormal albumin synthesis (Murray *et al*, 2006).

The results of this study show that protein intake affects levels of serum albumin. Mothers with low protein intake had lower serum albumin levels than mothers with adequate protein intake (3.104 ± 0.853 vs 3.736 ± 0.203 g/dl). Levels of serum albumin in pregnant women who experience CED are lower than in pregnant women who do not have CED, although statistically insignificant. This is because protein intake in pregnant women with CED and without CED were both low. Protein intake is related to the economic situation in the family. The low economic status has an impact on the low capability to purchase food in the household. In this study, 63.8% of pregnant women have low economic status, 85.4% had low protein intake and 34.6% pregnant women with CED. According to Petrika *et al* (2014), there is a meaningful relationship between energy and protein intake and the incidence of CED. Pregnant women with a low energy intake of 50% are at greater risk in the risk group of CED (50%), while for pregnant women with low protein intake, the proportion of risk is bigger (72.2%). Another research result also revealed a significant relationship between CED and food intake (energy and protein) (Rachmawati *et al*, 2019).

Low protein and energy intake between Weeks 24 and 44 can stunt fetal development (Marangoni *et al*, 2016). Protein and energy nutrient deficiencies in pregnant women can reduce the core of DNA and RNA and interfere with the profile of fatty acids, nutrition transfer from the mother to the fetus is impaired (Jouanne *et al*, 2021). Due to changes in protein structure, growth factor concentration, and neurotransmitter production, the brain size of the fetus may also be diminished by this mechanism (Wu *et al*, 2004).

In conclusion nutritional status is affecting levels of albumin serum in pregnant women in the Seluma region. Monitoring nutritional status and intake protein during pregnancy is essential for determining the health of the mother and baby during pregnancy.

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CONFLICT OF INTEREST DISCLOSURE

There are no potential conflicts of interest to declare

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