

Prosiding Prediction Model of Chronic Energy Deficiency

by Ummi Kalsum

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The Indonesian international conference bringing together a local and world
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October, 25-26, 2016

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Welcome Message

Governor of Jambi's Welcome Address

Excellences Rector of University of Jambi, in this occasion represented by Vice Rector of International Collaboration.

Honorable guests, keynote speakers, presenters and audience, Welcome to the first conference of ¹The 1st International Conference on Green Development (GDIC 2016)

It gives me great pleasure to welcome you all to this conference. This conference is organized by the biggest University in Jambi, it is University of Jambi.

Dear Audience

At this moment, As Governor of Jambi, firstly I would like to introduce you about Jambi, specifically in relation with interesting think to be known and visited. Jambi is dominated by Malay race and nominated by Chinese, Indian and Arabic descent. But we have other minorities who are living in the middle of forest in Sarolangun Regency, they are called Suku Anak Dalam or Orang Rimba⁵. Though Some Orang Rimba have decided to merge with locals and leave their old customs. The Anak Dalam (Children of the Forest) or more appealingly Orang Rimba (People of the Forest), some still maintain their age old belief--animism and maintain no contact with the outsiders.

Jambi has wonderful tourism area to be visited, such as Muaro Jambi Temple, the old temple heritage from the Buddha Kingdom in Sriwijaya Kingdom Era is around 26 km from central town of Jambi. The most interesting tourism Area in Jambi is Kerinci, it is 430km from this town. If you have time for visiting it, you will have a great pleasure hiking up volcano Kerinci, the highest active volcano in Indonesia. There is also Gunung Tujuh Lake, it's reputation as the highest volcanic Lake in South East Asia make the trekking/hiking to this place was so special. You find others interesting places in this area, Khayangan Park and Tapan Hill, Kerinci Lake, some Hot Springs, some waterfalls and others interesting cultural attraction in. In Jambi town it's self you can enjoy traditional food like Tempoyak, Pempek and local fruits such duku, duren and others kind of delicious fruits.

Distinguish guests, ladies and gentlemen

In relation with this even, since the conference raises 'green development theme', that is why that the theme of this conference links and matches with Jambi province program to develop all sectors of development, they are economics, education, science and technology, society and culture based on local wisdom and need. I expected this conference benefits scientists, policy makers and practitioners to design and develop all sector based on concept of 'green development'. And more, as it serves to foster communication among scientist, policy maker and practitioners working in those topics, we hope to have chances for mutual cooperation among the participants.

Finally I would like to use this opportunity to thank to Rector University of Jambi, Steering Committee, and International Committee and General Committee member for bringing Jambi name to global world through this conference.

I would like to thank you to all parties who have been working and collaborating to make this conference happen. Last but not least, I would like to express my appreciation and thanks to keynote speakers, presenters, and participants for your participation in this conference.

I wish you all the best for this conference. God bless us.

Governor of Jambi

Zumi Zola

Rector's Welcome Address

Ladies and Gentlemen

I welcome you warmly to the University of Jambi to participate The 1st International Conference on Green Development (GDIC 2016). With over 30,000 students and 1,600 employees in research, teaching and administration, the University of Jambi, which was founded in 1963, is currently the largest one in Sumatra. Our range of studies in 14 faculties which six of them are new faculties that officially established in these two years. The faculties are defined by great variety and scope. Currently, students can choose between more than 88 bachelor's, master's, diploma and doctoral programmes.

Dear Audience

As the biggest University in Jambi province, the University of Jambi has play an important role as a key-player in both Human and Natural resources Development in Jambi Province. We have successful develop cooperation in all sector of development in Jambi province. We have contributed in term of research, community service, consultancies, training services and providing some expert to speed the development of Jambi province. Today, the University of Jambi consistently seeks innovative methods to collaborate more strongly on an inter-discipline for the aim of conducting shared research relating to green development in all area of knowledge and sciences.

Ladies and gentlemen

In this opportunity, I would like to express that we are very fortunate to have you at the GDIC 2016. Particularly, this conference is organized by the Research and Community Service center or LPPM University of Jambi.

In this conference, we are very proud to have Ali Sophian Ph.D from International Islamic University of Malaysia, Meine van Noordwijk, Ph.D from World Agroforestry Center, Rachel Carmenta, Ph.D from Center For International Forestry Research, Prof. Dr. Syarif Hussin from Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Dr. Jesus C Fernandez from Deputy Director for Program SEAMEO BIOTROP for coming to our city.

I would like to thank all parties, especially the Lontar papyrus L.td, PetroChina Ltd., and BPJS Kesehatan for their contribution in the conference. I wish you all enjoyable sessions in the conference.

Rector of Jambi University

Prof. Johni Najwan, M.Hum, Ph.D

Chairman of Committee's Welcome Message

³ Distinguished guests, respected colleagues, and ladies and gentlemen. Firstly, I want to thank our god that has given us this opportunity to gather in this conference. It is the time successfully to wrap up a year's work. Considering just how busy you all must be, thank you very much for taking your precious time to participate in the 1st Green Development International Conference.

³ In particular, I would like to extend my gratitude to distinguished guests from abroad. First of all, please allow me to express my sincere appreciation for: Ali Sophian Ph.D from International Islamic University of Malaysia, Meine van Noordwijk, Ph.D from World Agroforestry Center, Rachel Carmenta, Ph.D from Center For International Forestry Research, Prof. Dr. Supyan Hussin from Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Dr. Jesus C Fernandez from Deputy Director for Program SEAMEO BIOTROP for coming to our city.

The approximate 120 abstracts received cover most typical aspects of the green development with four core topics: sustainable agriculture, green growth, green energy and technology, green course, Green Course redesign with technology. Leading plenary, keynote speakers, and oral presenters will present the latest advances in a variety of subjects ranging from instructional design to climate change. I welcome all of you and hope that today's event will serve as a catalyst for strengthening international cooperation on the transfer of green development.

In addition, I am most thankful for the ceaseless efforts of the head and staff members of the Institution for research and community services, and especially for all the members of committee that come from all faculty in University of Jambi. This conference, also supported by some institution, so I would like to say thank you to: WKS, Lontar Papyrus, Setara Institute, two Center of Excellence from University of Jambi; Wahyud and Rekla, and two research centre from University of Jambi; Energy and nano material Research Centre, Public Health Research Centre.

⁴ Once again, I am most grateful for your participation and support. Thank you very much.

Chairman of Committee

Nazarudin

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GREEN GROWTH

The 1st Green Development International Conference
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**Prediction Model of Chronic Energy Deficiency (CED) on Women of
childbearing age using
New Alternative QUAC-Stick**

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Abstract—Women of childbearing age (WCA) who suffer from chronic energy deficiency (CED) were relatively high in Indonesia, especially in pregnant women. WCA who suffer from CED will have a greater risk of morbidity and the risk of having low birth weight baby (LBW), death during childbirth, bleeding and difficult postpartum. The study examined several risk factors 6 CED on WCA using a new alternative QUAC Stick. This study was a cross sectional, used a part of National Basic Health Research (Riskesdas) 2013 data in Makassar and Tana Toraja, South Sulawesi. The subject were women (18-49 years), not pregnant as many as 1009. CED risk status was calculated using Mid Upper Arm Circumference/ $\sqrt{\text{Upper Arm Length}} < 4.25$ (a new QUAC-Stick). The risk factors assessed were age, age of first pregnancy, parity, contraceptive use, infectious diseases (malaria, pulmonary Tuberculosis or hepatitis), non-communicable diseases, hygiene behavior, physical activity, smoking, education, occupation, marital status, household members, the location of residence (urban-rural), environmental health, 9 using, family socioeconomic and health services accessibility. Chi-square and multiple logistic regression were used to obtain the relationship with $P < 0.05$. There were 19.03% of women have CED-risk. WCA 9 > 36 years were likely to be protected from the risk of CED (adjusted odds ratio (AOR) = 0.47; 95% confidence interval (95% CI) 0.30-0.73) whereas WCA aged <20 years more likely at risk by AOR = 1.73 (95% CI: 0.98-3.04) when compared to WCA 20-35 years old. Other risk factors were shown to increase the risk of CED: parity (1-3 children or 43 re), single, low socioeconomic as well as difficult access to health services. However, the use of hormonal contraceptives and non-horm 21 as protective factor, against the risk of CED, respectively AOR = 0.32 (95% CI: 0.17-0.61) and AOR = 0.47 (95% CI: 0.25-0.85). The dominant risk factor for CED-risk on WCA was severe infectious disease (AOR = 4.20 (95% CI: 1.29-13.62)). Reduction and prevention needs to be done in order to avoid WCA from severe infectious diseases by improving sanitation and housing as well as access to health services and also economic empowerment programs.

Keywords: CED, WCA, MUAC, arm length, quac-stick

1. INTRODUCTION

There were still many women of childbearing age (WRA) in Indonesia who suffer chronic energy deficiency (CED). CED was due to lack of food intake lasting chronically and may cause health problems (MOH, 1999). CED during adolescence may continue to pregnancy time caused by low energy and nutrient reserves. Pregnant woman who suffer from CED have the risk of morbidity and the risk of having a low birth weight (LBW) baby, death during childbirth, and hemorrhage,

postpartum were difficult because of weak and susceptible to health problems (Adriani & Wirjatmadi, 2012).

Many factors cause CED on WUS such as anemia, education level, employment, knowledge, age, socio-economic, contraceptive use, households size, maternal morbidity, diet and food taboos (Nurdiati, 1998; Sumarno, 2005; Sari & Irawan, 2009).

The prevalence of CED on WRA in developed countries is relatively low, but in developing countries is still high. In Indonesia, 13.6% WRA (15-45 years) had a risk of CED (MOH, 2008) increased to 20.8% in 2013 (MOH RI, 2014). In South Sulawesi, WRA at risk of CED were 16.5% (in 2007) increased to 25.1% in nonpregnant WRA and 31.2% in pregnant WRA (in 2013) (MOH, 2008; MoH RI, 2014). 35

The nutritional status of adults currently assessed by the Body Mass Index (BMI), which the status of CED measured by $\text{weight/height}^2 < 18.5$. BMI is a very good indicator for adult nutritional status assessment because it uses two 8 indicators of growth, namely body weight (a measure of tissue mass growth) and height (a measure of linear growth). But BMI still have several limitations : not practical because it uses two tools (scales and height measurement tools) so it is relatively expensive, can not be used to measure infants, children, adolescents, the elderly, pregnant women and also people who have problems to stand (do not have legs, paralysis, being bedridden), or hunchback. So the coverage of nutritional status assessment was limited and the prevalence of CED that recorded or reported today tend to be lower than the real problem in the community (underestimate and underreported) (Kalsum et al, 2014).

31 Mid risk assessment on WRA in Indonesia currently uses the mid upper arm circumference (MUAC) < 23.5 cm (MOH, 1999). MUAC is an anthropometric parameters that simple, inexpensive, practical and easy to do by staff who are not professional as village volunteers because it does not require special skills so that the most appropriate use in developing countries such as Indonesia (Krasovec & Anderson, 1991). MUAC is relatively stable, and often used as an indicator of nutritional status prepregnancy. MUAC can be used to measure the approximate of upper arm muscles and subcutaneous fat thickness estimate, so as to estimate a person's weight (Ariyani, Achadi & Irawati, 2012). Some studies found that MUAC was closely related to body weight and can be used as predictors of fetal weight, children, adults

and even in the elderly (Liang et al, 1997; Cattermole et al, 2010; Kalsum et al, 2014).

However, the MUAC alone can not comprehensively describe the nutritional status as a single indicator. MUAC has been developed in combination with other indices (called "QUAC Stick") including MUAC/height. Validity of MUAC/height better than using MUAC only (Gibson, 2005), but MUAC/height have a similar problem with a BMI as already mentioned.

MUAC obtained from measuring the length of the upper arm (from the elbow to the limit point of the arm bone at the base of the shoulder) as a central point for placing tape of MUAC. The length of the upper arm is used to get the MUAC size, but never used as an alternative parameter estimation for height (Kalsum et al, 2014). Whereas the studies in the forensic field, hand length or length of the upper arm are often used as an estimator to the person's height and proved have a strong correlation (Ahmed, 2013; Tugcu et al, 2006).

The purpose of this study was to develop a new QUAC-stick as a practical alternative, a simple but effective for assessing the risk of CED on WRA (18-49 years) of the Malays in Indonesia and also to identify risk factors of CED on WRA using these new indicators.

II. METHODS

The study design was cross-sectional. Using a part of data of National Basic Health Research (Riskesdas) 2013 and also primary data, held in the city of Makassar and Tana Toraja, South Sulawesi province. The collection of data of upper arm length done during the Riskesdas 2013 on May to July 2013, while the reliability test enumerators conducted in March 2014 in Makassar City.

The study population was women aged 15-49 years were selected as sample Riskesdas 2013 in the province of South Sulawesi. Samples were women aged 18-49 years who were respondents of Riskesdas 2013 in Makassar and Tana Toraja, not pregnant when the survey was conducted, willing to participate and the data filled in full in. A total samples of 1009 peoples. Enumerator reliability test conducted on 30 of WRA, sub-samples in the district of Rappocini of Makassar by 10 enumerators of Makassar and Tana Toraja Riskesdas 2013 enumerators.

Variables used include anthropometric data (weight, height and MUAC include the upper arm length), the characteristics of WRA (age, age of first pregnancy, parity and use of contraceptives), morbidity (disease infectious and non-infectious), lifestyle (personal hygiene, physical activity and smoking), socioeconomic (education, occupation, marital status, household's size and area of residence) as well as sociodemographic (environmental sanitation, housing, family socioeconomic and access to health facilities).

Height and weight were measured with a standard procedure and minimum clothing, didnot wear footwear. Standing height was measured using a portable measuring instrument made of super aluminium material which validity tested before used in Riskesdas 2013. Weight was measured

using a digital scale brand FESCO to the nearest 0.1 kg calibrated each day prior to data collection. Scales have tested the reliability and stability by weighing 610 peoples and proved stable than others. MUAC and upper arm length measurements performed using fiber glass tape to the nearest 0.1 cm.

CED assessed using BMI <18.5 and BMI ≥ 18.5 as not CED, while the risk of CED when MUAC < 23.5 cm. Validity was assessed using sensitivity and specificity, while the optimal cut point was assessed using ROC curves.

Age of WRA grouped into 20-35 years, > 35 years and <20 years, as well as the age of first pregnancy. The parity was divided into three criteria that have never, 1-3 peoples and ≥ 4 peoples. The use of contraceptives was divided into never used, never used hormonal or use of non-hormonal, and use of hormonal contraception.

Infectious diseases were divided into none, mild when suffering from ARI or Acute diarrhea or pneumonia, and severe when suffering from pulmonary tuberculosis, malaria or hepatitis. Non-infectious diseases were divided into no and yes when suffering from one of these diseases: Asthma/COPD, cancer, diabetes mellitus, coronary heart disease, kidney failure, kidney or stroke.

Personal hygiene was divided into good hygiene behavior if always wash their hands with soap before preparing food, every dirty hands, after defecation, after cleaning a baby, after using pesticides and before feeding the baby and poor hygiene behavior when it was not. Physical activity was divided into mild (doing sedentary activities conducted for ≥ 6 hours/day, 4-7 days a week); medium (engage moderate activity for 4-7 days a week and do more than 60 minutes/ day) and hard when doing strenuous activities for 4-7 days a week and do more than 60 minutes/day. Smoking was divided into never or had stopped and smoking (occasionally or every day).

WRA education levels were grouped into high when completed high school or more, and low when no school to high-school dropout. WRA job status was divided into working and not. Marital status was divided into married and not. Household's size were classified into ≤ 4 peoples or > 4 peoples. Living area was divided into a town or village.

Environmental sanitation and housing was assessed using the median and grouped into good when the total score ≥ median and less when < median. Socioeconomic level was divided into high when middle quintile, upper middle and top (quintiles 3-5), and low when quintiles 1-2. Access to health facilities include the presence of health facilities, ease of achieving it according to the distance and length of time as well as transport equipment, divided into easy/ difficult according to the median value.

Analyses were performed using STATA version 11.0 including the univariate analysis, bivariate analysis using Chi-Square test. ROC curves and AUC used to establish the optimal cut off point as well as evaluating the validity of the indicator using 2 x 2 tables to calculate sensitivity and specificity. Multivariate analysis using a Multiple Logistic Regression to get the final model.

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Ethical approval for this study was obtained from the Health Research Ethics Committee of Research and Development of the Ministry of Health and the Ethics Committee of the Public Health, University of Indonesia.

III. RESULT AND DISCUSSION

Table 1 shows that women being subject in this study were mostly aged ≤ 35 years, age of first marital between 20 to 35 years, have children 1 to 3 persons, use of contraception, not suffering from infectious diseases and non-infectious diseases. Most women have moderate physical activity and have never been or had quit smoking. The proportions of education levels were similar between high and low. Most of women were not working, married, number of household members more than 5 peoples. Most live in urban areas, the level of the middle to upper socioeconomic, accessibility to health services proportions were similar between easy and difficult.

Table 2 shows that most women's weight > 53 kg with an average height of 151 cm. MUAC and BMI mostly in normal size, upper arm length most of ≥ 31 cm.

Table 3 shows that the optimal formula that has more validity (based on the sensitivity and specificity) was $6 \text{ MUAC}/\sqrt{\text{UAL}} \text{ (in cm)} < 4.25$, better than $\text{MUAC} < 23.5$ cm to $\text{BMI} < 18.5$ as the gold standard. Although the validity of the performance more likely similar between $\text{MUAC}/\sqrt{\text{UAL}} < 4.25$ to $\text{MUAC} < 23.5$ cm.

Table 4 shows the risk factors for CED using the new indicators ($\text{MUAC}/\sqrt{\text{UAL}} < 4.25$). It were obtained eight variables that have a P-value < 0.25 (age, parity, contraceptive use, non-infectious diseases, education, occupation, marital status and access to health facilities) as well as three variables entered the model which consideration of the substance even though $P > 0.25$ ie infectious diseases, physical activity and socio-economic level.

There were eight variables as the final model to predict CED on WRA such as age, parity, contraceptive use, infectious diseases, physical activity, occupation, marital status and socio-economic level. The dominant risk factor was the use of hormonal contraception as a protective effect of CED on WRA after controlled by age, parity, infectious diseases and non-infectious, physical activity, education level, employment status, marital status, socioeconomic and access to health facilities.

Women of 36-49 years old have a smaller risk for CED when compared with WRA aged 20-35 years. However, women of 18-19 years old have greater risk for CED. WRA who use non-hormonal contraception/ never used contraceptives have lower risk for CED, and the risk was even higher when using hormonal contraception compared WRA who have never used contraception.

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Women that have parity 1 to 3 children had a greater risk than women who have never had children. Similarly, parity $\geq$

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4 children have a greater risk than women have none. WRA with moderate physical activity had tend to be a greater risk of CED but women who have hard physical activity actually have a lower risk compared to women who have light physical activity.

Women who have severe infectious diseases tend to have a greater risk than the healthy women, while women who suffered from minor infection have a same risk compared to women was not sick.

WRA employment status associated with the prevalence of CED, where WRA who work have a lower risk for CED compared to those have no work. Unmarried status were have a greater risk for CED when compared to married women. Women with low socioeconomic status, also have tend to increase the risk of CED when compared to high socioeconomic level.

In this study, the reliability test was also conducted to anthropometric measurements by measured on 9 enumerators compared to standard gauge on the sub sample Riskesdas 2013 in Makassar. There were no variations in measurements weight, MUAC and UAL both intra- and inter-reader, so there were no variation inter-reader measurements of height but there were still 11% of intra-reader variations in height measurements compared to standard gauge. Measurement agreement of $\text{BMI} < 18.5$ and $\text{MUAC} < 23.5$ cm among all enumerators showed excellent results (Kappa = 1 on BMI and between 0.9 to 1.0 on $\text{MUAC} < 23.5$ cm), but the data were not displayed.

BMI can not be applied to pregnant women, while the assessment of nutritional status during pregnancy is very important to prevent health problems of mother and her fetus. The study examines to develop a new QUAC-stick as an alternative indicator based on concept of BMI has not been done in any country. Therefore, results of this study have a novelty that need to be developed and further revalidation (Kalsum et al, 2014).

Validity assessment of the new instrument and compared to a gold standard is necessary to be done. Elements of validity are sensitivity (Sn) and specificity (Sp). Sensitivity is the ability of the tool to find those who suffer from the disease, whereas specificity is the ability of the tool to find those who do not suffer from the disease (Sutrisna, 2010).

This study found that the formula of $\text{MUAC}/\sqrt{\text{UAL}} < 4.25$ have the most optimal validity. The ability of $\text{MUAC}/\sqrt{\text{UAL}}$ finding the risk of CED as really CED is 80%. While the ability to recognize healthy women (not CED) is really not CED is 84%. This QUAC-stick had shown a good performance because the value of Sn and Sp were more than 70% (Waspadji, 2003; Kalsum et al , 2014).

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Table 1. Characteristics Sociodemographic of Respondents (n=1009)

Characteristics	n	%	Characteristics	n	%
Age			Physical activity		
20-35 year	501	49,7	Mild	383	38
36-49 year	67	6,6	Moderate	592	58,7
18-19 year	441	43,7	Severe	34	3,4
Age at first marriage			Smoking		
20-35 year	470	69,3	No/Stop	984	97,5
36-49 year	10	1,5	Yes	25	2,5
18-19 year	198	29,2	Education level		
Parity			High	578	57,3
Never	331	32,8	Low	431	42,7
1-3 child	431	42,7	Job Status		
>= 4 child	247	24,5	No Work	608	60,3
Contraceptive use			Work	401	39,7
Never Use	431	42,7	Marriage status		
Ever Use/Non hormonal	310	30,7	Married	677	67,1
Hormonal contraception	268	26,6	No	332	32,9
Infectious Disease			Household member		
No	908	90	<= 4 persons	460	45,6
Mild	90	8,9	=> 5 persons	549	54,4
Severe	11	1,1	Place of Live		
Non infectious disease			Urban	754	74,7
No	883	87,5	Rural	255	25,3
Yes	126	12,5	Social economic of household		
Health services accessibility			High	808	80,1
Easy	523	51,8	Low	201	19,9
Difficult	486	48,2			

Table 2. Numerical Conclusions from Anthropometric Variables

Variables	Mean (95% CI)	Median	SD	Range
Age (years)	33.2 (32.6-33.8)	33.0	9.2	18-49
Weight (kg)	53.9 (53.2-54.6)	52.1	10.8	25.8 -109.3
Height (cm)	151.3 (151.0-151.7)	151.6	5.7	105.1-170.2
BMI (kg/m ²)	23.5 (23.2-23.8)	22.8	4.5	13.0-54.0
MUAC* (cm)	26.6 (26.3-26.8)	26.1	3.7	15.3-41
UAL** (cm)	31.2 (31.1-31.4)	31.0	2.3	9-40

* 34 upper arm circumference;

** upper arm length

Table 3. Comparison of the Performance of Validity of Ratio of MUAC/ $\sqrt$ UAL and MUAC < 23,5 cm

Validity	MUAC/ $\sqrt$ UAL < 4,25 (95% CI)	MUAC < 23,5 (95% CI)
Sensitivity (%)	80 (70.8 – 87.3)	76 (66.4 – 84.0)
Specificity (%)	84 (81.4 – 86.3)	87 (84.9 – 89.3)
Positive Predictive Value (%)	35 (29.2 – 42.0)	40 (32.6– 46.9)
Negative Predictive Value (%)	97 (96.1 – 98.4)	97 (95.7 – 98.)
Positive Likelihood Ratio	5.0 (4.2 – 6.0)	6.0 (4.9 – 7.3)
Negative Likelihood Ratio	0.24 (0.17 – 0.35)	0,28 (0,20 – 0,39)
ROC (%)	82 (80.0 – 86.1)	82 (77.3 – 86.0)

Table 4. Selected Risk Factors of Chronic Energy Deficiency (CED) according to MUAC/ $\sqrt$ UAL < 4.25

Variables	Nutritional Status		Unadjusted POR (P-Value)	Adjusted POR (P-Value)	95% confidence interval
	CED n (%)	Not CED n (%)			
Age					
20-35 year	139 (27.7)	362 (72.3)	1		
36-49 year	53 (12)	388 (88)	0.36 (0.000)	0.44 (0.000)	0.29-0.66
18-19 year	34 (50.7)	33 (49.3)	2.68 (0.000)	1.61 (0.096)	0.92-2.81
Age at first marriage					
20-35 year	72 (15.3)	398 (84.7)	1		
36-49 year	1 (10)	9 (90)	0.61 (0.646)	-	-
18-19 year	29 (14.6)	169 (85.4)	0.95 (0.825)	-	-
Parity					
Never	124 (37.5)	207 (62.5)	1		
1-3 child	69 (16)	362 (84)	0.32 (0.000)	1.33 (0.442)	0.64-2.77
$\geq$ 4 child	33 (13.4)	214 (86.6)	0.26 (0.000)	1.46 (0.373)	0.63-3.37
Contraceptive Use					
Never Use	149 (34.6)	282 (65.4)	1		
Ever Use/Non hormonal	39 (12.6)	271 (87.4)	0.27 (0.000)	0.44 (0.007)	0.24-0.79
Hormonal contraception	38 (14.2)	230 (85.8)	0.31 (0.000)	0.43 (0.005)	0.24-0.77
Infection Disease					
No	203 (22.4)	705 (77.6)	1		
Mild	19 (21.1)	71 (78.9)	0.93 (0.786)	1.02 (0.931)	0.60-1.74
Severe	4 (36.4)	7 (63.6)	1.98 (0.278)	2.79 (0.119)	0.77-10.11
Non Infection Disease					
No	210 (23.8)	673 (76.2)	1		
Yes	16 (12.7)	110 (87.3)	0.47 (0.006)	-	-
Physical activity					
Mild	81 (21.1)	302 (78.9)	1		
Moderate	140 (23.6)	452 (76.4)	1.15 (0.363)	1.42 (0.039)	1.02-1.98
Severe	5 (14.7)	29 (85.3)	0.64 (0.377)	0.89 (0.882)	0.32-2.44
Smoking					
No/Stop	220 (22.4)	764 (77.6)	1		

Yes	6 (24)	19 (76)	1.1 (0.846)	-	-
Education Level					
High	148 (25.6)	430 (74.4)	1		
Low	78 (18.1)	353 (81.9)	0.64 (0.005)	-	-
Job Status					
No Work	152 (25)	456 (75)	1		
Work	74 (18.5)	327 (81.5)	0.68 (0.015)	0.68 (0.026)	0.49-0.96
Marriage Status					
Married	101 (14.9)	576 (85.1)	1		
No	125 (37.7)	207 (62.3)	3.44 (0.000)	2.02 (0.026)	1.09-3.75
Household's size					
<= 4 persons	110 (23.9)	350 (76.1)	1		
=> 5 persons	116 (21.1)	433 (78.9)	0.85 (0.291)	-	-
Place of Live					
Urban	171 (22.7)	583 (77.3)	1		
Rural	55 (21.6)	200 (78.4)	0.94 (0.713)	-	-
Social Economic of Family					
High	178 (22)	630 (78)	1		
Low	48 (23.9)	153 (76.1)	1.11 (0.573)	1.23 (0.329)	0.81-1.88
Health Services accessibility					
Easy	107 (20.5)	416 (79.5)	1		
Difficult	119 (24.5)	367 (75.5)	1.26 (0.126)	-	-

This new indicator is better than the MUAC only, though not too much difference. It can be said that the validity of the ratio of MUAC/ $\sqrt{\text{UAL}}$ non-inferior to the MUAC. Sensitivity and specificity of the diagnostic test known as a stable value, because it (perceived) does not change even the proportion of healthy or sick subjects was different or on low or high diseases prevalence (Sastroasmoro & Ismael, 2011). The high sensitivity is required in a diagnostic tool for detecting cases of serious impact, while the high specificity is required if subsequent treatment or care for the cases have a high risk (Fletcher, Fletcher & Wagner, 1992). CED have serious implications for WRA if not detected early, to the outcome of pregnancy, also impact on morbidity and mortality both in the WRA and fetus. So the more sensitive tool is better to detect the risk of CED. This is consistent with Sutrisna (2010) that when the test is used for case finding in order to get the treatment then the test with high sensitivity is more appropriate to use although specificity is sacrificed (Kalsum et al, 2014).

But when disease prevalence is low and there is no intention to ascertainment of the diagnosis, using the test that have a high specificity but lower sensitivity is more appropriate. This is due to the small number of true positives will become smaller, and their properties will be obscured by false positive (Sutrisna, 2010). This is consistent with the

purpose of developing a new indicators from QUAC- stick to detection for CED.

As a diagnostic tool to assess CED (case finding), the new alternative QUAC-stick have a good validity. Its validity is better than MUAC only because it has a higher sensitivity which leads to a lower false negative. However, it is required caution to application widely in society. Because it is need revalidation study in different populations using a higher causality study design and using BMI or BIA (bioelectrical impedance analysis) as a gold standard.

BMI concept is indicative of wasting when low weight associated with decreased soft tissue mass. Wasting occurs when there is an imbalance between energy needs and supplies of energy to the body. This is related to lack of food intake and the presence of infectious diseases. There is indirect evidence that the main cause of wasting is the lack of energy (Himes, 1991). Either BMI or the new QUAC stick are using the same concept of assessing thinness or acute wasting that can intervene immediately with recovery supplementary feeding. The concept of wasting is actually considering body proportions, because relatively to a person's height.

Height component consists of the upper limb (head, neck and trunk) and lower extremities (pelvis and legs). Growth of the trunk and extremities have a certain period of growth.

There is a difference in height composition according to their race or ethnicity (Kalsum et al, 2014).

The racial difference in the upper and lower segments have well known. Blacks have longer legs and shorter trunk than whites. Femur longitudinal growth more quickly in blacks, while slower growth in the spine (Wagner & Heyward, 2013). Asians have a longer trunk and shorter legs than the whites, Hispanics have the same body proportions as the white race, but shorter. Among the various population there were relative leg length differences. Differences in leg length usually found in various surveys, especially when weight is associated with height (BMI concept) in order to indicate obese or underweight. Length of leg should be measured, at least in simple forms such as knee length. There is possibility to conclude the obesity from the high value of weight/height when it have a short legs, or underweight from the low value of weight to height when it have a long legs (Jelliffe & Jelliffe, 1979).

This new QUAC stick used the upper arm length that proved empirically related to height. The upper arm length is a part of the upper limb which the proportion of the upper extremity length is relatively stable from birth to adulthood on a person's height about 10% (Sinclair, 1986). Similarly, the length of the trunk relatively constant from birth to adulthood in proportion to height. This indicates that the new indicator developed using the upper arm length is relatively stable to describe the nutritional status (an overview of linear growth).

Although there were differences in the proportion of length of vertebral or length of lower extremity to height in the various races in the world. But for Indonesian people, the proportion or composition of the vertebra or lower extremities were relatively similar among ethnic groups in Indonesia. It is expected result of this study can be applied as a new alternative indicator on WRA nutritional status in Indonesia and so to the ethnic that have same body proportions and composition namely the Malays or not Malays ethnic but have similar body composition.

On the other hand, BMI is a complex measure, but it is not sensitive to body composition. The short mothers can not be captured by BMI, especially when having a proportional weight to her height, so not detected as CED by BMI, when in fact they have a chronic nutritional problems (CED). However the new QUAC stick can precisely identify it. The role of the upper arm length is more visible in identifying CED on short mother, because the upper arm length is relatively independent to height (Kalsum et al, 2014).

The new alternative QUAC stick have better validity than MUAC and no need an additional measurement but only utilizing the upper arm length data measured when measuring MUAC. This study found that the validity of MUAC <23.5 was a good screening tool, but the Sensitivity is higher than the Specificity, so it caused a higher number of false positive cases. It pattern is similar to study found by Ariyani, Achadi & Irawati (2012) in Indonesia and Khadivzadeh (2002) in Iran. This study also showed the differences of prevalence of CED by BMI with prevalence of CED by a new indicator

(MUAC/ $\sqrt{PLA}$), due to different validity (Sn and Sp value) of each of these indicators. The apparent prevalence will be different from the true prevalence (in population) when the test is not perfect (Gerstman, 2003). It is also due to the limitations of BMI in detecting CED in the short mother, so prevalence of CED by BMI is much smaller. Short mother who have proportional weight to height detected by BMI as not CED. Therefore this new indicator precisely illustrates the CED problem actually exists in the population. This will have an impact on CED prevention programs.

The final model of the risk factors of CED using a new alternative QUAC-stick found that using hormonal contraception was a dominant factor, but protective. Similar results were found by previous studies (Nurdiati, 1998; Sumarno, 2005; Winkvist, 2000). Hormonal contraceptives may affect to the WRA hormonal responses which occur to body water retention that lead to increased fat in WRA (so it increasing weight) (Sriwahyuni & Wahyuni, 2012). The hormonal contraception users need to maintain nutritional status by applying a balance nutritional diet and exercise regularly.

While infectious diseases as a significant risk factor. These results are similar to those found by some studies (Sumarno, 2005; Ali & Lindstrom, 2005; Subramanian & Smith, 2006). Infectious diseases caused food intake disorder due to impaired absorption, increased catabolism and disposal of nutrients resulting in decreased nutritional status (Ehiri, 2009).

Factors that increase the risk of CED on WRA were age <20 years, which is similar to that found by Villamor (2006) and Subramanian, Kawachi & Smith (2007). Women aged <20 years were more concerned to their body image and diet due to have a slim body or thin (Almatsier, Soetardjo & Soekarti, 2011). Other factors that increase the risk of CED was a lot more parity, these results similar to the study of Villamor (2006) which found that parity ≥ 5 children increase the risk of CED on WRA. The more often birth will reduce the nutritional status of women, required spacing pregnancies and an increasing the age of first marriage for maintaining the women health (Achadi, 2012).

This study also found that moderate physical activity increase the risk of CED on WRA, it similar to Sari & Irawan study (2009). Food intake should be balanced with appropriate caloric based on her physical activity. CED prevention and control by increasing variety of food and reduce the workload on women (Achadi, 2012).

Not married women increase the risk of CED on WRA, this is similar to that found by Villamor (2006) and Harahap (2002). Unmarried women tend still young so it is more concerned to her body image and have a bad habit of food consumption which resulted in declining nutritional status.

This study also found that lower socioeconomic may increase the risk of CED on WRA. These findings similar with studies in India and Indonesia (Nurdiati, 1998; Sumarno, 2005; Ali & Lindstrom, 2005; Ehiri 2009; Villamor, 2006). Poverty is a major factor for malnutrition (Caulfield, Richard

& Rivera, 2006). The high economic family more able to provide diverse food and meet the nutritional needs than low socioeconomic family (Almatsier, Soetardjo & Soekarti, 2012). High socioeconomic with higher education have healthier eating patterns. Purchasing ability is an important factor in the selection of food (Gibney et al, 2008).

Preventing CED, attempt to communication, information and education for women who play an important role for the children health, families and themselves with balanced nutritional diet and a healthy lifestyle. Also, empowerment of women to contribute improving the family economy through utilization of her home yard. The main efforts is role of government in providing small capital for developing family's income, in addition applying CED screening on risky WRA, extended the scope to health workers and efforts to assess the nutritional status independently by using this new indicator periodically and continuously.

Finally, Validity of the new QUAC stick ($MUAC/\sqrt{UAL} < 4.25$ better than the validity of MUAC in detecting the risk of CED on WRA with BMI < 18.5 as a gold standard. Revalidation studies required before the new QUAC stick (named UMMI index) will applied widely in the community with some advanced studies in several different places or applying to the another race, using the gold standard BIA, calculate the cost effectiveness of the program and implement countermeasures of CED at different target groups can also be developed to detect the risk of obesity in WRA.

CED is also necessary reduction efforts through communication, information and education to the public and proper handling by adopting a healthy lifestyle and balanced nutrition diet. Reach the adolescent girls through schools, as well as using the social media such as facebook and twitter to inform about healthy and balanced eating pattern, monitoring CED independently, application of a clean and healthy lifestyle and prevention of CED effective manner.

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