

IMPROVEMENT OF METABOLIC DISORDERS AND NUTRITIONAL INTAKE AND ANTHROPOMETRIC STATUS STUNTING TODDLERS WITH CYSTEINE AMINO ACID SUPPLEMENTATION

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ABSTRACT

Overcoming nutritional problems including stunting in Indonesia has been carried out through various programs launched by the government. However, problem of stunting in infants is still high at 35.6% compared to the MDGS target of 15%. Adequat of macro and micro nutrient intake is an important element in overcoming the problem of stunting. The amino acid cysteine is one of the amino acids that can help the process of accelerating growth. In the growth process, the amino acid cysteine has a role in accelerating the transcription of hormone receptors in the reaction of zinc finger protein (ZFP), induction of Transforming Growth Factor β (TGF β) and the formation of CRIP (Cystein Rich Intestinal Protein) which are strongly associated with advanced metabolic reactions in forming energy for growth. The pre-post randomized design control study was conducted in two sample groups, control and treatment. A total of 30 stunting toddlers. The treatment group was given 25 mg of cysteine amino acid / day with the time of administration for 3 months or 90 times. Indicator of metabolic disorders using the urinalysis method to analyze urine protein content, intake level was measured using a 24-hour Food Recall and anthropometric measurements which Body Weight and Height. Results of the study showed that giving amino acid cysteine could not improve metabolic disorders in stunting infants with indicator urinalysis. The level of macro and micro nutrient intake is not in accordance with the needs of toddlers. There was a significant change in anthropometric status in the treatment group. Suggestions for further research should be to measure indicators of improvement in metabolic disorders with more accurate blood specimens.

Keywords: Cysteine Amino Acid, Height, Intake of Nutrition, Stunting Urinalysis, Weight.

INTRODUCTION

Most children who experience nutritional problems including stunting experience metabolic disorders. This is caused by the mechanism of action of the Insulin Receptor Substrate (IRS) found on the cell membrane. The bond between insulin and the IRS will produce a signal that plays a role in the process of glucose metabolism in muscle cells and fat (Rifai, 2008).

The glucose metabolism that occurs in the liver functions as a means of transporting glucose through the cell membrane. The liver has a role in regulating body glucose homeostasis. In a state of deficiency in the intake of glucose sources there will be an increase in endogenous blood sugar levels from the process of gluconeogenesis and glycogenesis in liver tissue. If insulin control is normal (Gibson, 2006).

If insulin resistance occurs as in stunting children, the over-inhibitory effect of insulin hormone on the mechanism of endogenous glucose production does not occur optimally, thereby increasing glucose production in the liver. So more glucose in undernutrition children than endogenous systems. The impact of the many endogenous systems as a source of glucose in stunting children will decrease appetite as

a result of low glucose uptake from exogenous (Jeremie, 2010).

Endogenous metabolism that occurs in stunting toddlers can be responded to by fulfilling the intake of nutrients, especially energy and protein sources. Availability of cysteine amino acids is absolutely necessary in the metabolic reaction given Cystein Rich Intestinal Protein (CRIP) is an element needed in the reaction of metabolites macro nutrients and micronutrients. The amino acid cysteine is a semi-essential amino acid that is not fully supplied by the body, so it needs to be fulfilled in the form of supplementation (Linder, 2006).

One indicator that can measure the metabolic processes that occur in the body is through the results of metabolic discharge. Urine is the result of the body's metabolism released through the kidneys. Routine urine examination includes: urine count, macroscopic (color and clarity), specific gravity, protein, glucose, ketone objects and sediment examination is one indicator that can be used to assess a person's metabolic status. In stunting toddlers, it is also necessary to evaluate intake levels and anthropometric status such as periodic Body Weight and Height.

RESEARCH METHODS

Research design

This research is an experimental study with Randomized Pre-Post Test Control Group Design. The treatment approach used the Double Blind Methods method. The sample in this study was Stunting. The overall sample is 30 samples which are divided into 15 treatment groups and 15 control samples.

Data collection

Giving cysteine amino acid: Is the administration of amino acid cysteine obtained from PT. Autocindo Indonesia. Tasteless and white like flour. The dose given is 25 mg / day with the time of administration for three (3) months or 90 times given.

Measurement of metabolic disorders by the urinalysis method. Finalysis is a test performed on urine samples of stunting toddlers using Urinalysis Reagent Strips. The indicators measured include urine protein.

Data analysis

Analysis of the results of the research data was carried out in a descriptive and analytical. Data were analyzed descriptively and presented in the form of frequency distribution, cross tabulation, average value and Standard Deviation (SD). Nutrition intake was measured by using Food Recall 24 hours 3 times during the study. Anthropometric status is measured by measuring body weight and height every month during the study.

Statistical analysis used to test hypotheses using paired t-test to test the difference in measurement results of indicators of metabolic disorders, nutrient intake and anthropometric status before and after cysteine amino acid supplementation.

RESEARCH RESULT

Table 1. shows that all samples experienced linear growth problems with the shortest category reaching 73.3% in treatment and very short reaching 46% in controls.

Sample Characteristics	Treatment		Control	
	n	%	n	%
TBU				
Short	8	53,3	11	73,3
Very short	7	46,7	4	26,7
Total	15	100	15	100
BB / U	n	%	n	%
Good nutrition	8	53,3	9	60
Malnutrition	6	40	4	26,6
Nutrition is very lacking	1	6,7	2	13,4
Total	15	100	15	100

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Results of Urinalysis

In this study the indicator of metabolic disorders measured is the status of urine protein which can describe the disruption of protein absorption as a result of malnutrition which results in low levels of albumin. The description of the urine status of the sample can be seen in table 2. The results of research on urinalysis are grouped on the results of protein examination because it is seen from that urine protein.

Table 2. Urine Protein Status of Samples

Nutritional status	Treatment				Control			
	Before		After		Before		After	
Urine Protein	n	%	n	%	n	%	n	%
+++	1	6,7	1	6,7	1	6,7	1	6,7
+	11	73,3	11	73,3	12	80,0	12	80,0
0	3	20	3	20	2	13,3	2	13,3
Total	15	100	15	100	15	100	15	100

Table 2 shows changes in urine protein status in both treatment and control. The most obvious change was seen in the treatment where the status of urine protein with the normal category was 20%. Likewise + protein status from 73.3% and urine protein +++ 6.7%. At the end of the study there was no change in urine protein level status.

Different tests to distinguish the results of treatment and control between before treatment and after the treatment were carried out Wilcoxon test with the test results for treatment and control equal to p value = 1,000 this shows no significant effect in both the treatment group and the control group. To see the interrelationships between groups carried out the Mann Witney test. The results of this test show results that are

not significant with each p value of 0.389 for the pre test and 0.436 for the post test.

Both groups showed the occurrence of metabolic disorders seen from the results of examination of urine protein, there were some who experienced positive results. This shows a sign of starvation and dehydration conditions in stunting toddlers. The results of fluid measurements in the sample show that the average consumption of drinking water in the sample does not meet daily needs. Where most of the samples consume only 2-3 glasses of water (600 ml) much smaller than their minimum requirements of 1000-1200 ml.

In this study, in addition to measuring metabolic disorders urinally, it also measured the level of energy and nutrient intake both macro and micro.

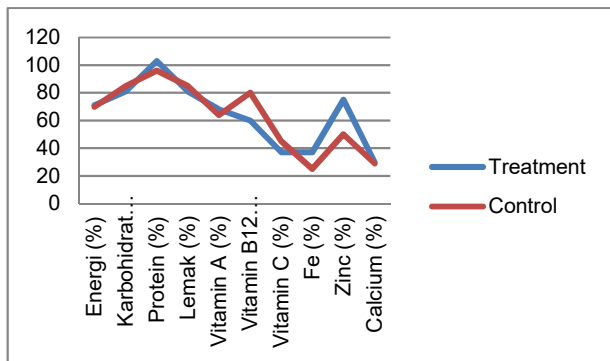


Figure 1: Results of Measurement of Macro and Micro Nutrition

Intake Levels on Samples. In Figure 1, it can be seen that almost all nutrient intake in the treatment and control on average does not adequat of the toddler age group when compared to the guide to nutrition adequacy.

Anthropometric status Body Weight and Body Height. Measurements for each sample are carried out every month. To assess the accuracy of this measurement. To avoid mistakes because of the environmental factors when measuring, home visits are measured, where samples feel more comfortable and calm because they are measured at home. The average changes in Body Weight and Height can be seen in Figure 2 and Figure 3

Figure 2 Differences in Body Weight Before and After Treatment in Research on Improvement of Metabolic Disorders in

Post-Stunting Cysteine Amino Acid Supplement

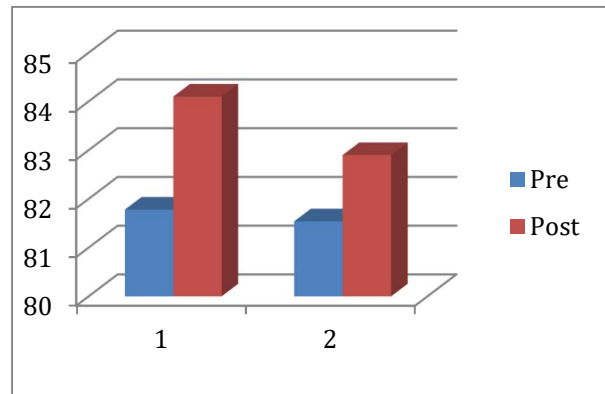


Table 3. Changes In Body Weight In The Treatment And Control Groups

Weight	Before	After	p
Treatment	11,40 ±0,86	11,57 ±0,91	0,108
Control	11,14 ±1,69	11,34 ±1,48	0,057
p value between groups	0,382	0,178	

Table 3 provides an overview of the mean changes in body weight in the sample. In the treatment, the average Body Weight increases by 0.17 Kg from 11.40 Kg with a variation of 0.86 Kg to 11.57 Kg with a variation of 0.91 Kg. The results of the t test show a p value of 0.010, this shows a significant increase for Body Weight in the treatment before and after treatment. Likewise with the control there was a significant change with a p value of 0.057.

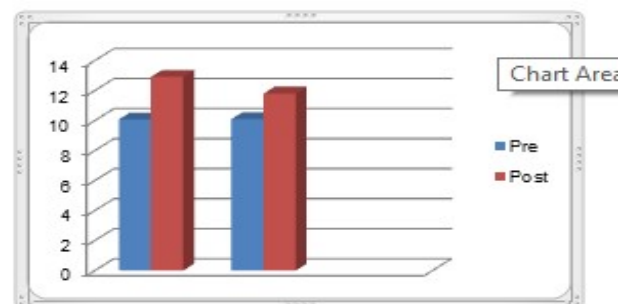


Figure 3 Differences in Height Before and After Treatment in the Study of Improvement in Metabolic Disorders of Post-Stunting Cysteine Amino Acid Supplement

Table 4. Changes In Height In The Treatment And Control Groups

Height	Before	After	p
Treatment	81,68 ± 0,82	83,53 ± 1,77	0,054
Control	81,74 ± 0,83	82,81 ± 0,77	0,003
p value between groups	0,985	0,820	

Table 4 illustrates changes in Height before and after treatment. On average treatment increases Height by 1.85 Cm from 81.68 Cm with variations of 0.82 to 85.53 Cm with a ratio of 1.77 Cm. The results of the t test show p value of 0.054, this indicates an increase in Height that is significant between before and after treatment in group 1, as well as in group 2 there is a change in the same with p value of 0.003.

DISCUSSION

One pathway of energy formation through increased delivery of fatty acids to the muscles or decreased intracellular metabolism of fatty acids causes an increase in intracellular fatty acid metabolites such as diacylglycerol, acyl fatty CoA. This metabolite activates serine/threonine kinase initiated by protein kinase to cause serine / threonine phosphorylation of sites on insulin receptor substrates (IRS-1 and IRS-2), which in turn can reduce the ability of insulin substrate receptors to activate PI3-kinase. As a result, glucose transport activities and insulin signaling receptor events are reduced (Department of Medicine, 2012).

The fact that the results of these studies can be attributed to the role of IRS 1 in the metabolism of nutrients. Glucose metabolism that occurs in the liver, where GLUT2 functions as a means of transporting glucose through the cell membrane into cells. The liver has a role in regulating body glucose homeostasis. In a state of deficiency in glucose source intake, there will be an increase in endogenous blood sugar levels originating from the process of gluconeogenesis and glycogenesis in liver tissue. This process takes place normally if insulin control is normal (Asman, 2014).

Cysteine as an amino acid also has several biological roles caused by its molecular structure which can be through oxidation or reduction reactions. Cysteine has different functions related to its stable structure, so it can be catalytic in various translational. Thus, it can be concluded that cysteine is an amino acid that must be fulfilled in the growth process, especially in

the period of solving nutritional problems such as in short toddlers (Muhtarudin, 2011).

Cysteine and histidine if bonded with zinc will form a stable bond, where 4 cysteine residues which are bound to zinc will form four thiolate-Zn 2 + which are strong and large elements. This element is stable as a disulfide in the cytosol, so it can be a good amino acid catalyst in reduction and oxidation reactions in some metals, for example between Zn 2 + and sulfur, where zinc will bind stronger to carry out the oxidation process, so the amino acid cysteine which binds to zinc can oxidize rapidly in the cytosol, thereby producing energy quickly (Linder, 2006).

In this study it was found that almost all nutrient intake in the sample was not sufficient for Nutritional Adequacy Rates. As explained in the IRS 1 and insulin mechanism, that in children who experience shortness, there will be a decrease in appetite as a result of the high endogenous pathways used to meet glucose needs as an energy source, so it is deemed necessary to provide additional food and nutritional supplements in Stunting. Martha *et al*, research explained that in children who had vitamin A deficiency 23.2% experienced short and 8.7% had a malnutrition status. This does not have a significant relationship between low vitamin A intake and retinol P value = 0.9185. This study concluded that in stunting children, intake of vitamin A from food cannot increase retinol levels, so supplementation of high doses of vitamin A is needed (Martha, 2012).

Another factor causing short-term toddlers is nutrient deficiency in both macro and micro. Micronutrients that influence linear growth are zinc and vitamin A. As reported by Sonja from HarvesPlus Research which examines some of the results of research related to nutritional issues including linear growth disorders in infants (Sonja, 2005). Taufiqurrahman also examined the tendency of short events at <12 months to> 36 months. This study proves that vitamin A and zinc deficiency is a short-term risk factor for toddlers in West Nusa Tenggara Province. Growth failure in children, besides being caused by vitamin A deficiency, is also associated with zinc deficiency. The manifestation of zinc deficiency is a linear growth disorder in infants which is indicated by the incidence of short children (Taufiqurrahman, 2009).

Meera K Chagan concluded the results of his research that the administration of multiple micronutrients in combination with vitamin A is very appropriate to increase growth in short children compared with the provision of vitamin A and zinc or only given vitamin A alone. However, efforts to meet the energy needs of macro nutrients such as carbohydrates, fats and proteins must be adequate. Restrictions on energy intake, protein, and some micronutrients can cause limited synthesis of specific proteins such as RBP to mobilize and transport vitamin A (Chagan, 2010).

In this study significant results were obtained for the anthropometric status of the treatment group. Addition of amino acids can protect protein degradation, so that it can increase the absorption of other nutrients. Sulfur amino acids such as cysteine amino acids are limiting amino acids that need to be added as precursors that can help metabolic processes by increasing nutrient absorption (Muhtaruddin, 2011).

The purpose of giving amino acids in this study is to accelerate the process of cell differentiation, so that it can help speed bone growth in short toddlers. (Nazanin, 2012). In situations like this, food intake, especially the regulation of proteins such as cysteine amino acids is a very important part of preventing short-term toddlers. Nutritional problems of children under five are strongly related to nutrient intake at this time (WHO, 2007).

CONCLUSION

1. Giving cysteine amino acids cannot not improve metabolic disorders in stunting toddlers with urine protein indicators
2. Indicators of urinalysis are less sensitive in the assessment of metabolic disorders
3. The level of macro and micro nutrient intake is not in accordance with the needs of toddlers. There was a significant change in anthropometric status in the treatment group.

REFERENCES

- Almatsier Sunita, Susirah Soetardjo, Moesijanti Soekatri. (2011), *Gizi Seimbang Dalam Daur Kehidupan*, Gramedia Pustaka Utama Jakarta, Jakarta p :278-313
- Arnelia; dkk. (2010), “*Besaran defisit zat gizi makro dan mikro pada anak baduta dengan masalah kurus di perdesaan dan perkotaan di Indonesia.*” *Laporan Penelitian .Info pangan dan Gizi Media Penyalur Info Pangan dan Gizi. Kementerian Kesehatan Republik Indonesia Info Pangan dan Gizi Volume XXI No. 1 Tahun 2012*
- Aritonang Irianton. (2010), *Menilai Status Gizi Untuk Mencapai Sehat Optimal*. Leutika dengan CEBios, p. 1-8
- Aritonang Irianton. (2012), *Perencanaan dan Evaluasi Program Intervensi Gizi Kesehatan*, Kerjasama CEBios-Jurusan Gizi & Leutika, Leutikabook, p. 532-535
- A Rome Paek, Seok Hyun Kim, Sun Shin Kim, Kyung Tae Kim and Hye Jin You. (2010), “*IGF-1 Induced expresion of zinc-finger protein 143 in colon cancer cells throught phosphatidylinositide 3 – kinase and reactive oxygen species*”, *Experimental and Molecular Medicine*, Vol 42. No 10, p 696-702
- Bapenas. (2011), *Rencana Aksi Nasional Pangan dan Gizi 2005-2015*. ISBN 978-979-3767-68-9
- Barasi Maria E.At a Glance (2009), *Ilmu Gizi*. Jakarta ; Erlangga, p. 124-129
- Cornelius M Smuts, Carl J. Lombard, A.J.Spinnler Benade et.al. (2005), “*Efficacy of a Foodlet-Based Multiple Micronutrient Suplement for Preventing Growth Faltering, Anemia, and Mikronutrient Deficiency of Infants : The Four Country IRIS Trial Pooled Data Analysis*,” *J. Nutri*.135 , p. 631S-638S
- Gibson Rosalinds. (2006), *Prinsiples of Nutritional Assessment*. New York Oxford, Oxford University Press.
- Grober Uwe. (2013), *Mikronutrien. Penyelesaian Metabolik, Pencegahan dan Terapi*, Alih bahasa, Amalia H.Hadinata, S.Farm,Apt, editor Juia ita Panggabean, S.Farm.Apt. Penerbit Buku Kedokteran EG, p. 167-170
- Imdad, Aamer Zulfiqar A Bhutta, (2010), *Effect of preventif zinc supplementation on linear growth in children under 5 years of age in developing countries : Meta analisis of studies for input to the lives saved tool*
- Imogen S Rogers, David Gunnell, Pauline M.

- Emmett, et al. (2005), *Cross-sectional Associations of diet and Insulin-Like Growth Factor Levels in 7-to 8-Year-old children*,. *Cancer Epidemiol Biomarkers Prev* , 14, p. 204-212.
- Jeremie Boucher, Yu-Hua Tseng, and C.Ronald Kahn. (2010), *Insulin and insulin-like growth factor-1 Receptors Act as Ligand-specific Amplitude modulators of common pathway regulating gene transcription*, *The journal of biological chemistry* vol.285.no 285 no.22 p. 17235-17245
- Joanne E.Arsenault, Daniel Lopez de Romana, et al. (2008), *Additional Zinc Delivered in Liquid Supplement, but Not in Fortified Porridge Increased Fat-Free Mass Accrual Among Young Peruvian Children with Mild-to-Moderate Stunting*, *J.Nutr.*138 p. 108-114
- Kemenkes. (2012), *Profil Data Kesehatan Indonesia Tahun 2011*. Kementerian Kesehatan Republik Indonesia
- Kuntoro. (2011), *Metode Statistik*. Edisi Revisi. Pustaka Melati
- Linder Maria C. (2006), *Biokimia Nutrisi dan Metabolisme*. EGC Jakarta
- Macdonald Ian A and Helen M Roche.(2007), *Nutrition and Metabolism*, edited Michael J.Gibney. NS Blackwell Publissing.
- Mary E Penny, R Margot Marin, Augusto Duran, Janet M Peerson, Claudio F Lanata, Bo Lonnerdal, Robert E Black and Kenneth H Brown. (2006). *Randomized controlled trial of the effect of daily supplementation with zinc or multiple micronutrients on the morbidity, growth, nad micronutrient status of young Peruvian children*, *Am J Clin Nutr* : 79,p. 457-465
- Martha I. Kartasurya, Faruk Ahmed, Hertabio W Subagio, Muhammad Z Rahfiludin dan Geoffrey C Marks.(2012), *Zinc combined with vitamin A reduced upper respiratory tract infection morbidity in a randomised trial in preschool children in Indonesia*, *British Journal of Nutrition*, 2012 p: 1-10
- Meera K Chhagan, Jan Van Den Broeck, Kany-Kany A Luabeya, Notobeko Mponstershane, Andrw Tomkins and Michael L Bennish. (2010), *Effec on longitudinal growth and anemia of zinc or multiple mikronutrien added to vitamin A : a randomized controlled trial in children age 6-12 mont*, *BMC Public Health* 2010, 10: 145 p: 1-11
- M. Jane Heinig, Kenneth H Brown,Bo Lonnerdal, and Katryn G Dewey.(2006). *Zinc Supplementation does not effect growth, morbidity, or motor development of US term breastfed infants at 4-10 mo of age*, *Am J Clin Nutr* 84 ,p. 594-601.
- Muzamil Shabana Ejaz,Nazia latif. (2010), *Stunting and micronutrien deficiencies in malnourished children*, *J pak Med Assoc Vol* 60.No 7, p. 543-547
- Prihatini, Sri; dkk. (2010), *Asupan dan tingkat kecukupan konsumsi zat gizi mikro penduduk Indonesia*. Laporan Penelitian .Info pangan dan Gizi Media Penyalur Info Pangan dan Gizi. Kemeterian Kesehatan Republik Indonesia Info Pangan dan Gizi Volume XXI No. 1 Tahun 2012
- Rifai Muhaimin. (2009)., *Signal Tranduksi dan Sistem Pertahanan Tubuh*. Jurusan Biologi Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Brawijaya Malang, p. 1-16.
- Sanjaya,dkk. (2009), *Kamus Gizi . Pelengkap Kesehatan Keluarga*. Jakarta: Kompas Media Nusantara, p. 185-229
- Solomon Noel W, M.D and Robert M. Russell, M.D. (2009), *The Interaction of Vitamin A and Zinc implication for human nutrition*, *The Amarican Journal of Clinical Nutrition* 33 p; 2031-2040
- Solomon Noel W. (2013). *The importance of dietary and environmental zinc for human health can be ignored only at signifikant peril to child well-being throughtout the word*, *Ann Nutr Metab* , 62 (suppl 1) 8-17
- Supariasa et al. (2010), *Penentuan status gizi* edisi Revisi EGC Jakarta
- Sunita Taneja, Tor A.Strand ,Halvor Sommerfelt, Rajiv Bahl and Nita Bhandari, (2010) *Zinc Supplementation for four months does not affect growth in young north Indian children*. *The Journal of Nutrition* 140.,p. 630-634
- Taufiqurrahman. (2009), *Defisiensi Vitamin A dan Zinc Sebagai Faktor Risiko Terjadinya Stunting Pada Balita Di Nusa Tenggara Barat*. Media Penelitian Dan Pengembangan

Kesehatan 19 (3), 2009.

WHO. (2005), *Who Child growth standards and the identification of severe acute Malnutrition in infants and children.*

Unicep

WNPG. (2004), *Ketahanan Pangan dan Gizi di Era Otonomi Daerah dan Globalisasi*, Persagi, Pergizi Pangan dan PDGM. Lipi Indonesia