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Research Article
Correlation Between Dietary Intake with Anthropometry Profile on Youth Football Athlete in Indonesia

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Abstract
Background and Objective: Nutrition as one of the elements that affect the performance of athletes is often overlooked by some athletes, trainers and policy makers in Indonesia. Some issues related to nutrition are still commonly found in athletes in Indonesia both anthropometric, biochemical, clinical and food intake, so it is essential to continuous improvement. Aim of the study wanted to asses the contribution of dietary intake to the nutritional status of both anthropometric, somatotype and biochemistry in athletes. **Materials and Methods:** This study is an observational study with a longitudinal cohort design. Subjects were observed within a period of four months for the observed pattern of nutrient intake, anthropometric, somatotype, blood and urine biochemistry. Research conducted at the Young Athletes Dormitory Ragunan, Indonesian Ministry of Youth and Sport, RI Jakarta and SSB ASIFA-Aji Santoso International Football Academy, Malang. The total subjects who participated in this study were 131 youth footballers. Statistical testing was using multiple regression analysis. **Results:** The result indicate that intake of energy, protein, fat and carbohydrates significantly influence changes in anthropometric indicators of body height and height/age ($p = 0.00$). Energy intake, fats and carbohydrates have a significant effect on body weight, BMR, BMI and muscle arm ($p<0.05$). Energy intake, fat and carbohydrates affect the mesomorph somatotype components ($p = 0.00$). Macro-nutrient intake did not leave significant relationship to changes in blood biochemistry ($p>0.05$). Increased energy intake will lower urine specific gravity ($p = 0.023$) and urine pH ($p = 0.004$). Increased protein intake lowers the pH of urine ($p = 0.019$). Increased fat intake will lower urine specific gravity ($p = 0.028$). Increased carbohydrate intake will lower specific gravity and pH of urine ($p = 0.003$). **Conclusion:** In this study we found a significant correlation between intake on macro-nutrients with changes in body weight, height, mesomorph on somatotype component. Somatotype component is the important assessment on athlete. The fulfillment of energy must be achieved even though there are various modifications adjustment on the intake of protein, fat and carbohydrates.

Key words: Dietary intakes, anthropometry, somatotype, mesomorph, athlete, nutritional status, football, biochemistry, assessment

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Factors that affect the athlete's performance are skills, physiological condition of athletes and athlete management. The results of study[1] shows not only skills but also training management include coach and medical team have affect performance. Physiological conditions also determine performance such as heart rate, blood pressure, type of somatotype, hydration status and nutritional status[2-4].

Nutritional status is a condition that visible or not visible on the body of a person as a result of daily food consumption. Nutritional status can be seen from matching between type of somatotype and kind of sports[5-7]. Dietary intake also affects athlete's performance, where athlete with less nutritional status can be not optimal on the performance[8].

Nutrition as one of the elements that affect performance of athletes is often overlooked by some athletes, trainers and policy markers in Indonesia. Some issue related to nutrition are still commonly found in athletes both anthropometric, biochemical, clinical and dietary intake[9]. Data from union of football in Indonesia also known as PSSI[10] shown that 53.33% body fat soccer athletes U-19 is excessive and percent of body fat increased during holidays. It is also shown that 27% athletes experienced change on weight after holidays. The data also suggest that 73% and 26.7% athletes experienced with hypercholesterolemia and hyperuricemia[10].

Problems either anthropometry, somatotype or biochemistry in athletes is related to diet and dietary intake, therefore this study wanted to know how big contribution dietary intake on nutritional status of antropometry, somatotype and biochemistry in athletes.

MATERIALS AND METHODS

Study area and population: This study is an observational study with a longitudinal cohort design. Subjects were observed within a period of 4 months for the observed pattern of dietary intake, anthropometric, somatotype, blood and urine biochemistry. Research conducted at the Young Athletes Dormitory Ragunan, Indonesian Ministry of Youth and Sport, Jakarta, Indonesia and SSB ASIFA-Aji Santoso International Football Academy, Malang, Indonesia in January to June, 2016. The total subjects who participated in this study were 131 youth footballers. This study received approval from the Ethics Committee of the Medical Research and Health, Faculty of Medicine, Universitas Gadjah Mada Indonesia with ref No. KE/FK/102/EC/2016 dated February 1, 2016.

Dietary intake: Dietary intake was to determine total intake of both macro and micro-nutrients that are consumed by athletes during a specific time period. Method of 3×24 h food recall used for pre-intervention. Food waste analysis method used for monitoring progress and semi-quantitative food frquency were examined every week to see the number and eating patterns of athletes outside the hostel. Data scale is ratio for energy is calories and gram for proteins, fat and carbohydrates.

Antropometric data: Body weight was measured at baseline and daily monitoring (before and after exercise). Body weight was measured with digital scale Krada Scan brand HBF-375, the scale on ratio with unit on kilogram. Height was measured by using microtoise with GEA brand. Height was measured at the beginning and at the end of study. The scale measurement is ratio and unit on centimeter. Body composition is measurement to determine body fat percentage (%), visceral fat, Basal Metabolim Rate (BMR) with calories for unit, Body Mass Index (BMI), body age (years), segmental subcutaneous fat (%) and segmental skeletal muscle (%). Body composition measurement using BIA Karada Scan HBF-375 and measured at baseline and month monitoring.

Somatotype data: Somatotype is the body type of a person and it is categorized into three types namely endomorphy, mesomoprhy, ecomorphy who represented in the same order and can not alone. Measurement of somatotype include skinfold (triceps, subscapular, supraspinale and calf), width of bone (humerus and femur bioepicondillar), calf circumference, maximum arm circumference, height and body weight. The measurement results then formulated into formula of Carter[11] and plotted using somatochart. Instrument for assessment using harpender skinfold caliper, meiden spreading caliper, ABN metline, digital karada scan HBF-375, GEA microtoise and somatochart. Somatotype measured at baseline and month monitoring.

Biochemistry data: Biochemistry measurement consists of blood and urine biochemistry. Glucose, uric acid, cholesterol, hemoglobin and hematocrit for blood biochemistry then urine color and specific gravity for urine biochemistry. Glucose, uric acid, hemoglobin, hematocrit and cholesterol is a fasting blood measurement as a form of screening to determine nutritional status. Blood measurements performed after fasting for 8 h (allowed to drink water) using screening tools easy touch GCU meter. Measurements conducted at the beginning and once month monitoring. Scale for result is ratio with unit of mg dL^{-1}. Urine color is morning urine examination and varies from pale yellow to dark amber depending on concentration of urokrom, urobilin and uroeritrin. Scale measurement is ordinal with 1-4 U. Urine specific gravity is viewed as total solids concentration in the urine. Subjective density observed by using aution sticks 10 EA code 73591 and scale measurement on ratio. Results of urine specific gravity used to determine hydration status with category from Armstrong. Measurement for profile urine conducted at first and once month monitoring.

Statistical analysis: Univariate analysis is used to describe each variables in the study by looking at the frequency distributiion of dependent variables (anthropometry, somatotype and biochemistry) and independent variables (energy, carbohydrate, protein and fat intake). Data was analyzed using SPSS which includes mean, median, standard deviation, minimum, maximum frequency and normality test (normal when $p>0.05$). Bivariate analysis was used to see the relationship between dietary intake with anthropometry, somatotype and biochemistry.

RESULTS

Socio-demographic characteristics: Table 1 shows that 73.3% subject came from javanese followed by other tribes in Indonesia. Major distribution of age was 12-15 years (68.7%) and majority muslim (95.4%). Most of subject have joined football team for 4 years (73.3%) and majority subject having competition 2 or 3 times (48.1%).

Statistical analysis: Table 2 demonstrates average data after 4 months intervention. The data showed that average weight and height was 54.9 kg and 164.4 cm. Composition of total body fat was 14.5% with 20.2 kg m^{-2} for BMI. The highest of percent fat distribution on arms and legs. It can be seen that percent muscle on legs as big as on arms (37.2%). Profile of somatotype was 2.7-4.3-3.2 or 3-4-3. Nutritional status based on BMI/A and height/age indicates that all subject in normal nutritional status. Whole blood bichemical assessmen results within normal limits and hydration status from color of urine indicates subject on mild hydration. Average of nutrition intake of energy, protein, fat and carbohydrate was 1775.5 cal, 93.99, 67.98 and 238.15 g. Normality test results showed that carbohydrate intake, endomorph, urine specific gravity and pH urine indicates data was not normal but we used transformation data for intake of carbohydrate.

Table 3 shows statistic correlation test between intake of energy, protein, fat and carbohydrate with normal data of anthropometry, somatotype and bichemical variabels. Results indicates significant relation between intake energy with body weight, height, BMR, BMI, endomoprh, mesomorph, height/age, urine specific gravity and pH of urine ($p<0.05$). Intake protein significant associated with urinary pH ($p<0.05$). Intake of fat have significant relations with body weight, height, BMR, BMI, endomoprh, mesomoprh, height/age and urine specific gravity ($p<0.05$). Intake carbohydrate significantly associated with body weight, height, BMR, BMI, endomoprh, mesomoprh, height/age, urine specific gravity and pH urine ($p<0.05$). Dietary intake was not significant influenced on biochemical variabel ($p>0.05$). This was related to data distribution were within normal limits, eating pattern of subject research did not much affect on blood biochemical profile. From Table 3 we know that increased intake energy will decrease specific gravity and pH urine. Increase on intake protein would decrease density of urine and increase on intake carbohydrate will decrease pH urine.

Table 1: Socio-demographic characteristics

Information	n	%
Tribe		
Jawa	96	73.3
Sumatera	11	8.4
Kalimantan	9	6.9
Sulawesi	7	5.3
Papua	1	0.8
NTB/NTT	2	1.5
Bali	5	3.8
Total	131	100.0
Age (years)		
12-15 years	90	68.7
15-19 years	41	31.3
Total	131	100.0
Religion		
Islam	125	95.4
Hindhu	2	1.5
Budha	1	0.8
Kristen	3	2.3
Total	131	100.0
Duration joining with football team (years)		
0-4	96	73.3
5-8	24	18.3
9-12	11	8.4
Total	131	100.0
Duration having competition (week^{-1})		
0-1	34	25.9
2-3	63	48.1
4	34	26
Total	131	100.0
No. of football clubs		
0-1	83	63.4
2-3	43	32.8
4-5	5	3.8
Total	131	100.0

Table 2: Results of subject assessment

Parameters	Min	Max	X	SD	p-value*
Weight (kg)	33.8	81.9	54.9	10.9	0.943
Height (cm)	141.4	185.2	164.4	9.7	0.527
Body composition					
Body fat (%)	7.5	23.0	14.5	2.9	0.939
BMR (cal)	1026.0	1834.0	1404.1	182.4	0.990
BMI (kg m^{-2})	15.4	25.5	20.2	2.2	0.852
Segmental subcutaneous fat (%)					
Whole body	5.2	16.2	10.1	2.1	0.925
Trunk	0.0	14.6	8.5	2.2	0.894
Arm	10.3	24.7	15.9	2.8	0.978
Leg	8.7	24.3	14.8	2.9	0.817
Segmental skeletal muscle (%)					
Whole body	28.4	40.7	37.2	1.8	0.652
Trunk	15.8	37.8	32.7	2.5	0.237
Arm	38.5	48.1	42.9	1.6	0.945
Leg	50.0	57.7	54.4	1.5	0.994
Somatotype					
Endomorph	1.2	5.7	2.7	0.8	0.035
Mesomorph	2.0	6.7	4.3	0.9	0.867
Ectomorph	1.4	5.4	3.2	0.9	0.408
Nutritional status (WHO-anthro)					
BMI/age	-1.88	1.42	-0.09	0.7	0.683
Height/age	-2.30	2.79	0.20	1.1	0.660
Blood biochemical					
Glucose	66.0	112.0	82.9	7.7	0.639
Uric acid	3.1	9.0	5.4	1.2	0.921
Cholesterol	142.5	230.5	185.3	17.5	0.977
Hemoglobin	10.7	18.1	14.5	1.3	0.975
Hematocrite	32.1	54.5	43.6	4.1	0.994
Urine biochemical					
Specify gravity	1.0	1.1	1.0	0.0	0.000
pH	5.1	6.1	5.5	0.2	0.002
Color of urine	1.5	6.7	4.3	1.1	0.291
Dietary intake					
Energy (kcal)	1113.85	2723.14	1775.50	358.91	0.198
Protein (g)	56.94	137.46	93.99	14.13	0.893
Fat (g)	41.03	108.10	67.98	13.49	0.663
**Carbohydrate (g)	148.80	430.61	238.15	69.08	0.629

*Normality test with Kolmogorov-smirnov, **Transformation data with ln, Min: Minimum, Max: Maximum, SD: Standard deviation

Table 3: Correlation analysis between dietary intake with independent variabels

	Energy		Protein		Fat		Carbohydrate	
Parameters	R	Sig	R	Sig	R	Sig	R	Sig
Weight (kg)	0.351	0.000*	0.054	0.541	0.299	0.001*	0.376	0.000*
Height (cm)	0.399	0.000*	0.114	0.194*	0.308	0.000*	0.455	0.000*
Body composition								
Body fat (%)	-0.098	0.264	-0.102	0.247*	-0.034	0.696	-0.141	0.108*
BMR (cal)	0.383	0.000*	0.085	0.335	0.314	0.000*	0.417	0.000*
BMI (kg m^{-2})	0.219	0.012*	0.019	0.829	0.206	0.018*	0.221	0.011*
Segmental subcutaneous fat (%)								
Whole body	-0.043	0.623	-0.078	0.374	0.011	0.900	-0.073	0.409
Trunk	0.024	0.784	-0.026	0.769	0.080	0.361	-0.024	0.784
Arm	-0.055	0.231*	-0.117	0.182*	-0.009	0.914	-0.083	0.348
Leg	-0.052	0.557	-0.103	0.241*	0.000	0.999	-0.080	0.361
Segmental skeletal muscle (%)								
Whole body	0.078	0.377	0.074	0.400	0.030	0.732	0.119	0.175*
Trunk	-0.058	0.512	0.107	0.224*	-0.074	0.403	-0.054	0.543
Leg	0.058	0.514	0.098	0.267	-0.004	0.966	0.101	0.252
Arm	-0.152	0.082*	0.049	0.579	-0.155	0.078*	-0.103	0.240*

Table 3: Continue

	Energy		Protein		Fat		Carbohydrate	
Parameters	R	Sig	R	Sig	R	Sig	R	Sig
Somatotype								
Endomorph	-0.417	0.000*	-0.008	0.925	-0.369	0.000*	-0.416	0.000*
Mesomorph	-0.445	0.000*	0.071	0.421	-0.350	0.000*	-0.440	0.000*
Ectomorph	-0.005	0.958	0.063	0.472	-0.049	0.577	0.017	0.850
Nutritional status (WHO-anthro)								
BMI/age	0.134	0.127*	0.036	0.682	0.149	0.089*	0.120	0.172*
Height/age	0.399	0.000*	0.143	0.104*	0.312	0.000*	0.437	0.000*
Blood biochemical								
Glucose	0.015	0.867	-0.064	0.466	0.019	0.831	0.018	0.839
Uric acid	-0.038	0.666	-0.009	0.919	-0.061	0.487	-0.10	0.911
Cholesterol	0.057	0.520	-0.029	0.745	0.022	0.801	0.062	0.482
Hemoglobin	-0.045	0.607	0.024	0.782	-0.004	0.965	-0.063	0.472
Hematocrite	-0.039	0.658	0.024	0.782	0.008	0.931	-0.053	0.546
Urine biochemical								
Specify gravity	-0.199	0.023*	-0.109	0.216*	-0.193	0.028*	-0.165	0.003*
pH	-0.248	0.004*	-0.205	0.019*	-0.160	0.068*	-0.261	0.003*
Color of urine	-0.051	0.564	-0.156	0.075*	-0.039	0.662	-0.048	0.584

*p<0.25 can proceed to linear regression analysis, Sig: Significant

DISCUSSION

There is still lack of research on effects dietary intake with nutrition profile in athletes. Previous study[12] described relationship between eating pattern and type of food consumed by athletes with nutritional status while others[9] examined relationship food intake and food preferences where there was no significant correlation between eating preferences with the fulfillment of micronutrients. Another study[13] shows that nutrition knowledge was positively correlated with fat free soft tissue mass. Study on correlation between dietary intake with anthropometry and biochemical it still lack. Anthropometry in athletes is an important part, where it can obtained somatotype condition that can be used to determine suitability of body shape with kind of sport that was involved.

Multiple regression tests were carried out through following models. Model 1 until 4 shows on Table 4, model 1 presented multiple regression for intake energy, carbohydrate, protein and fat on height and height/age ratio. These result indicate that both independent variables had significant association with dietary intake (p = 0.00). Model 2 demonstrate multiple regression for intake energy, fat and carbohydrate on BMR, BMI, muscle arm, mesomorph and BMI/age. A significant relationship for all variables except BMI/age (p<0.05). Model 3 presents multiple regression for intake energy and protein were not significant influenced fat in the arm (p = 0.410). Finally model 4 shows intake protein and carbohydrate were not significantly associated with body fat (p = 0.473).

Table 4: Multiple regression between variables

Variable independent	Variable dependent	R	Sig
Intake energy, carbohydrate, protein and fat	Height	0.454	0.000
	Height/age	0.418	0.000
Intake energy, fat and carbohydrate	Body weight	0.427	0.000
	BMR	0.450	0.000
	BMI	0.317	0.004
	Muscle arm	0.285	0.013
	Mesomorph	0.464	0.000
	BMI/age	0.169	0.295
Intake energy and protein	Fat arm	0.118	0.410
Intake protein and carbohydrate	Body fat	0.108	0.473

Sig: Significant

Table 5: Regression equation for intake energy, protein, fat and carbohydrate

Model	B	SE	t	Sig
Height				
Constant	229.684	36.716	6.256	0.000
Energy	0.014	0.005	2.644	0.009*
Protein	-0.004	0.062	-0.068	0.946
Fat	-0.189	0.131	-1.445	0.151
Carbohydrate	-14.298	6.446	-2.218	0.028*
Height/age				
Constant	1.479	4.228	0.350	0.727
Energy	0.002	0.001	2.923	0.004*
Protein	0.000	0.007	-0.040	0.968
Fat	-0.020	0.015	-1.309	0.193
Carbohydrate	-0.557	0.742	-0.750	0.455

SE: Standard error, Sig: Significant, *p<0.05

After multiple regression test, Table 5 provides an information of contribution for both variables independent with equation:

$$Y = 229.7+0.014 \text{ energy}-0.004 \text{ protein}-0.189 \text{ fat}-14.298$$

for height with significant contribution from intake energy and carbohydrate. Profile of nutrition status from height/age is achievement of growth in height according to the age. According to Table 5 it can be seen intake energy has a significant role with equation:

$$Y = 1.479+0.002 \text{ energy}+0.000 \text{ protein}-0.020 \text{ fat}-0.557 \text{ carbohydrate}$$

Therefore, Table 6 shows intake carbohydrate gives an important significant role on body weight, BMR, BMI and muscle arm by lowering amount of intake carbohydrate. Variabel independent mesomoprh significantly influenced by lowering intake energy.

Nutrient intake are things to consider when doing physical activity. Energy in the form of ATP obtained from change of carbohydrate, fat and protein are used for energy source for muscle. Amount of ATP stored in muscle is relatively small so as to perform long duration of activity needs to resintesis ATP through a change of phosphocreatinin, carbohydrate and fat. The greatest source for resintesis ATP is carbohydrate, as well as in the study the biggest proportion of dietary intake was carbohydrate[14-16] which was reaches 60%.

Table 6: Regression equation for intake energy, fat and carbohydrate

Model	B	SE	t	Sig
Body weight				
Constant	159.394	41.353	3.854	0.000
Energy	0.008	0.006	1.369	0.173
Fat	-0.072	0.148	-0.487	0.627
Carbohydrate	-21.259	7.118	-2.987	0.003*
BMR				
Constant	3028.938	684.874	4.423	0.000
Energy	0.185	0.096	1.917	0.057
Fat	-2.117	2.450	-0.864	0.389
Carbohydrate	-338.275	117.884	-2.870	0.005*
BMI				
Constant	41.256	8.739	4.721	0.000
Energy	8.755	0.001	0.071	0.943
Fat	0.008	0.031	0.255	0.799
Carbohydrate	-4.072	1.504	-2.707	0.008*
Muscle arm				
Constant	26.594	6.328	4.203	0.000
Energy	0.000	0.001	0.477	0.635
Fat	-0.011	0.023	-0.471	0.639
Carbohydrate	3.042	1.089	2.793	0.006*
Mesomorph				
Constant	3.514	3.285	1.070	0.287
Energy	-0.002	0.000	-3.392	0.001*
Fat	0.017	0.012	1.461	0.146
Carbohydrate	0.443	0.565	0.783	0.435
BMI/age				
Constant	2.026	2.905	0.697	0.487
Energy	0.000	0.000	-0.274	0.784
Fat	0.008	0.010	0.750	0.454
Carbohydrate	-0.458	0.500	-0.916	0.361

SE: Standard error, Sig: Significant, *p<0.05

Table 6 shows positive relationship between intake carbohydrate with muscle in arms and whole somatotype. According to previous research of Gravina *et al.*[17], which also showed a positive association between increased intake carbohydrate with lean body mass and decrease in muscle tissue damage. As discussed elsewhere[18] endomorphy somatotype relation with intake dietary macro while mesomorph relationship with intake energy, fat and carbohydrate. Endomorph shows proportion of fat while mesomorph shows proportion of muscle in body.

Increase levels of carbohydrate can reduce creatine kinase and lactate dehydrogenase in muscle tissue where creatine kinase and lactate dehydrogenase known as parameters for damage cells particularly after heavy activity. Increased in intake carbohydrate, especially foods containing high fiber such as fruits and vegetables contain high levels of antioxidant can protect muscle tissue from damage due to fatigue after exercise.

Intake of energy giving positive correlation with body weight. It is also consistent with another study of Paulin *et al.*[19] which was increasing in total energy approaching positively associated with weight gain in athletes with endurance category. The study also mention that group has a lower energy intake proven experience weight loss than group who was consume higher energy. It is found that body weight have correlation with intake energy, fat and carbohydrate. In previous study of Salarkia *et al.*[20] found same result when body weight is correlation with dietary intake while other Raschka and Aichele[18] shows no significant correlation.

Model 3 on Table 4 shows intake energy and protein was not associated with bofy fat in arms. Model 4 provides intake protein and carbohydrate was not significantly associated with total body fat. Another study of Kirwan *et al.*[21] also revealed similar results where after 8 weeks intervention of energy and protein intake was not associated with fat and blood bichemical levels including cholesterol, triglycerides and LDL. Other study of Oliver *et al.*[22] also showed similar results during 12 weeks of intervention where there was not correlation between dietary intake and total body fat.

CONCLUSION

In this study we found a significant correlation between intake on macro-nutrients with changes in body weight, height, mesomorph on somatotype component. Somatotype component is the important assessment on athlete. The fulfillment of energy must be achieved even though there are various modifications adjustment on the intake of protein, fat and carbohydrates. The intake of energy, protein, fat and carbohydrates significantly influence changes in anthropometric indicators of body height and TB/U ($p = 0.00$). Energy intake, fats and carbohydrates have a significant effect on body weight, BMR, BMI and muscle arm ($p<0.05$). Energy intake, fat and carbohydrates affect the mesomorph somatotype components ($p = 0.00$). The fulfillment of such energy must be achieved even though there are various modifications adjustment on the intake of protein, fat and carbohydrates. Macro-nutrient intake did not leave significant relationship to changes in blood biochemistry ($p>0.05$). Increased energy intake will lower urine specific gravity ($p = 0.023$) and urine pH ($p = 0.004$). Increased protein intake lowers the pH of urine ($p = 0.019$). Increased fat intake will lower urine specific gravity ($p = 0.028$). Increased carbohydrate intake will lower specific gravity and pH of urine ($p = 0.003$).

SIGNIFICANT STATEMENTS

In this study we found a significant correlation between intake on macro-nutrients with changes in body weight, height, mesomorph on somatotype component. Somatotype component is the important assessment on athlete. The fulfillment of energy must be achieved even though there are various modifications adjustment on the intake of protein, fat and carbohydrates.

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