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Research Article
Correlation Between Nutritional Status and Lifestyle for Youth Soccer Athlete Performance: A Cohort Study

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Abstract
Background and Objective: Factors that influence athletes' physical performance include somatic factors, training adaptation, nutrition, cigarette, alcohol and caffeine consumption habits and psychological factors. As one of the elements that affect an athlete's performance, nutrition is often overlooked by athletes, trainers and stakeholders in Indonesia. This study aimed to determine the relationship between nutritional status, exercise and cigarette, alcohol and caffeine consumption habits and youth soccer athletes' performance. **Methods:** This observational study used a longitudinal cohort design. Subjects were observed for a 4 months period. A total of 131 youth soccer athletes participated in the study. Bivariate analysis was used to determine the relationship between all the predictor variables and the athletes' performance using Pearson's correlation coefficient and multiple regression tests. **Results:** Anthropometric measurements, biochemical, clinical, food and fluid intake factors were found to be significantly related to maximal oxygen consumption (VO2 max) ($p<0.05$). Anthropometric, biochemical, clinical, food and fluid intake factors had an effect on VO2 max: $r = 0.552$, $r = 0.215$, $r = 0.424$ and $r = 0.553$, respectively. The correlations across all variables were significant ($p = 0.000$), with a value of $r = 0.698$, if smoking habits, alcohol consumption, caffeine and exercise factors were neglected. The r-value increased to $r = 0.706$ for the following variables, smoking habits, alcohol consumption and caffeine consumption. The r-value increased to $r = 0.725$ by adding the exercise factor. Furthermore, it was found that variable body mass index (BMI) for age, ectomorph body type, heart rate, fluid intake and exercise were the main factors affecting VO2 max ($p<0.05$). **Conclusion:** Nutritional factors (69.8%) were found to have the greatest impact on an athlete's performance. The nutritional factors that had the greatest impact on performance are: BMI for age, ectomorph body type, heart rate and fluid intake without ignoring the exercise factor. Exercise and nutritional factors were found to have a 72.5% impact on an athlete's performance.

Key words: Alcohol, athlete, caffeine, cigarette, exercise, football, hydration, nutrition, performance

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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

According to the Federation International Football Association (FIFA), in 2015 the Indonesia football team was ranked 165th internationally and 33rd in Asia, consequently, Indonesia has not been able to participate in the World Cup football contest. This world-recognized match is a benchmark for the success of a football team in any country. The lack of participation in the World Cup shows that football in Indonesia lags far behind global level achievement in soccer. Factors that influence an athlete's physical performance include somatic factors, adaptation training, nutrition, cigarette, alcohol and caffeine consumption habits and an athlete's psychological status. The somatic factors include sex, age, body size and health status, which influence the performance of athletes. All of these factors contribute to the supply of fuel energy through the process of intake, absorption and distribution of food in the body[1].

Other factors can contribute to increase the uptake of oxygen through the respiratory system and to increase an athlete's capacity to control cardiac stroke volume, heart rate and oxygen extraction. The contribution of energy and oxygen uptake on an athlete's performance is influenced by two external factors, the environment and the type of exercise. Environmental conditions, such as altitude, barometric pressure, heat and cold, can affect an athlete's energy and oxygen uptake. The types of exercise as well as the intensity, duration, technique, position, rhythm and exercise schedule, also affect an athlete's energy needs and oxygen uptake. All these factors influence the supply of energy needed to achieve optimum physical performance[2,3].

Strategic efforts have been made to improve an athlete's performance using scientific approaches, including examining the factors that influence performance, such as genetics, potential and basic capabilities, training and exercise programs, engineering skills and athletic skills, social conditions, infrastructures, facilities, weather and climate, psychological conditions, self-confidence and motivation and rewards as well as the function of organs and nutrition[2-5]. Some issues related to nutrition are still commonly found in concerns about Indonesian athletes, particularly in regard to anthropometric measurements, biochemical, clinical and food intake factors. To ensure the best athlete's performance results, it is important to progressively and continually improve these influential factors[6]. While nutrition is one of the essential elements that influences an athlete's performance, it is often ignored by athletes, trainers and policy makers in Indonesia.

Data from the Football Association in Indonesia (PSSI) obtained in 2014 has shown that, for a U-19 football athlete, 53.33% body fat is excessive. Moreover, the athletes also tend to have increased body fat during holiday competitions. Studies have also indicated that 27% of athletes experience an increase in body weight during the off season. Nutritional biochemistry data show that 73.3 and 26.7% of youth football athletes have hypercholesterolemia and hyperuricemia, respectively, although 100% of the athletes do not have any problems with blood glucose level[7].

From the data presented above, it is observed that the nutritional status of athletes in Indonesia is still less than optimal. Thus, this study aimed to examine the nutritional factors that have an impact on athletes' performance, it also aimed to determine the extent to which each factor influenced an athlete's performance. The results can be used to reinforce that proper sports nutrition plays an important role in an athlete's performance.

MATERIALS AND METHODS

Trial design: This research study received ethics approval from the Medical and Health Research Ethics Committee, Faculty of Medicine, Universitas Gadjah Mada, Indonesia (Ref: KE/FK/102/EC/2016) on February 1, 2016. This observational study uses a longitudinal cohort design. Subjects were observed for a 4 month period. The following variables were measured, anthropometry, somatotype, biochemistry, hydration status, clinical assessment, food intake, fluids, exercise, smoking habit, alcohol and caffeine consumption and athletic performance. The study began with a description of the research and a signatory to the informed consent of the research subjects. Once a month for 4 months, we measured food intake using a 3×24 h food recall technique. Anthropometry, somatotype, biochemical and clinical aspects were monitored for 4 months. Performance was measured at the final stage of data collection. All data are presented in the form of an average of 4 months and were used for further data analysis.

Study population and participants: This research study was conducted from January-June, 2016 at the Ragunan Young Athletes Dormitory, Kemenpora RI Jakarta and at the Sekolah Sepak Bola (SSB) Aji Santoso International Football Academy (ASIFA). The target population is male soccer athletes and the population target is youth soccer athletes. The inclusion criteria for this study are: A youth soccer athlete, actively practicing, ranging in age from 12-19 years and willing to participate in the study by signing an informed consent. The exclusion criteria are: Athletes that were injured while initially participating in the research study. A total of 131 youth soccer athletes participated in the study.

Variables

Nutrition intake: Nutrition intake is the total intake of macro and micro nutrients consumed by an athlete during a specific time period. The study measured nutrition intake every month using a 3×24 h food recall technique. A ratio scale was used to measure the data. The units of measurement are calories for energy and grams for protein, fat and carbohydrates.

Fluid intake: Fluid intake is the total beverage intake, it was measured using a semiquantitative fluid questionnaire (every month). A ratio scale was used to measure the data. The unit of measurement is mL.

Weight: Weight refers to the body weight measurement. Body weight was measured pre and post-exercise using a Karada Scan HBF-375 digital scale (Omron Healthcare, Inc., China). A ratio scale was used to measure the data. The measurement unit is kg.

Height: Height refers to the body height measurement obtained using a GEA microtoise (PT Intimedika Sarana, Bandung, Indonesia). Height was measured at the beginning and end of the study. A ratio scale was used to measure the data. The measurement unit is cm.

Body composition: An analysis of body composition was used to determine body fat (%), visceral fat, basal metabolic rate (BMR) (cal), body mass index (BMI) (kg m^{-2}), body age (years), segmental subcutaneous fat (%) and segmental skeletal muscle (%) using bioelectrical impedance analysis (BIA) with a Karada Scan HBF-375. Body composition was measured once a month. A ratio scale was used to measure the data.

Somatotype: Somatotype is the body type of a person categorized as endomorph, mesomorph and ectomorph. The components of somatotype are skinfold measurements (triceps, subscapular, suprailiaca and calf), bone width (humerus biepicondylar, biepicondylar femur), calf circumference, maximum arm circumference, height and weight. The measurement results were then formulated into a Carter Formula[3]. The following instruments were used to measure somatotype: A Harpenden skinfold caliper, a Meiden spreading caliper, ABN Metline automatic measuring tape (Baty International, West Sussex, UK), a Karada Scan HBF-375 digital scale, a GEA microtoise and a somatochart. Somatotype was measured at the beginning of the study and it was monitored once a month. A nominal scale was used to measure the data.

Glucose, uric acid, cholesterol: A fasting blood test to screen for glucose, uric acid and cholesterol levels was used to determine the nutritional status of the athletes by evaluating the biochemical components found in blood. Blood tests were performed after the subjects had fasted for 8 h (allowed to drink water) by taking peripheral blood (fingertip) using the Easy Touch GCU meter screening tool (Global Medical Market Corp., Seoul, Korea). A blood test was conducted at the beginning of the study and was repeated once a month to monitor changes. A ratio scale was used to measure the data. The measurement unit is mg dL^{-1}.

Hemoglobin: Blood hemoglobin levels were screened and used to determine the nutritional status of athletes by evaluating the biochemical components of the peripheral blood (fingertip) that was collected using the HemoSmart Gold (Global Medical Market Corp., Seoul, Korea) testing system. Hemoglobin levels were tested at the beginning of the study and they were monitored once a month. A ratio scale was used to measure the data. The measurement unit is g dL^{-1}.

Hematocrit: Blood hematocrit levels were screened to determine the nutritional status of athletes by evaluating the biochemical components of the peripheral blood (fingertip) that was collected using the HemoSmart Gold testing system. Hematocrit levels were tested at the beginning of the study and monitored once a month. A ratio scale was used to measure the data. The measurement unit is %.

Urine color: Urine color is a morning urine examination that includes evaluating the color, clarity, pH and urine specific gravity. The subjects' urine profile was observed at the beginning of the study and it was monitored once a month. Urine color varies from pale to dark yellow, depending on the concentration of urochrome, urobilin and uroerythrin. An ordinal scale was used to measure the data. The parameters are 1-4.

Urine specific gravity: Urine specific gravity is the total concentration of solids in urine. The subjective density was observed using Aution10 EA code 73591 test sticks. A ratio scale was used to measure the data. Hydration status was based on the Armstrong category, ranging from hyper hydration to severe dehydration[7]. Urine specific gravity was measured at the beginning of the study and it was monitored once a month.

Hydration: Hydration status refers to the body weight change before and after exercise. A ratio scale was used to measure the data. The measurement unit is kg.

Exercise: Exercise refers to the frequency of exercise during 1 week. A ratio scale was used to measure the data. The measurement unit is times per week.

Cigarette use/smoking habits: Cigarette use is the number of cigarettes smoked in a day. A ratio scale was used to measure the data. The measurement unit is butt per day.

Alcohol consumption: Alcohol consumption is the number of shots of alcohol consumed in a day. A ratio scale was used to measure the data.

Caffeine intake: Caffeine intake is the number of cups of coffee consumed in a day. A ratio scale was used to measure the data.

Athlete's performance: Athlete's performance was measured by evaluating aerobic capacity/maximal oxygen consumption (VO2 max) using a multi step test. A ratio scale was used to measure the data. The measurement unit is mL kg^{-1} b.wt. min^{-1} [8].

Statistical analysis: Univariate analysis was used to describe each of the variables examined in the study by evaluating the frequency distribution of the dependent variable (athletes' performance) and the independent variables (anthropometric profile, somatotype, biochemical levels, clinical findings, hydration status and food and fluid intake). The data were analyzed using software that calculated the mean, standard deviation, minimum-maximum, frequency, percentage and normality test results for the data. In the test for normality, using the Kolmogorov-Smirnov test, when $p>0.05$ the variables have normal distribution. Bivariate analysis was used to determine the relationship between all the predictor variables and the performance of athletes using Pearson's correlation analysis and multiple regression analysis.

RESULTS

Participants: At the beginning of the study, the total population at the two research sites consisted of 170 athletes. At the end of the study, only 131 subjects were still participating in the study, 39 subjects dropped out for the following reasons: Out of school, illness, injury, participating in Umrah, regional sports competition selection and returning to home. The socio-demographic characteristics of the subjects are presented in Table 1. As seen, 73.3% of the subjects are Javanese, followed by other tribes in Indonesia. Most of the subjects (68.7%) were in the 12-15 years of age range and the majorities (95.4%) were Muslims. Most (73.3%) had been members of their soccer team for 4 years and the majority (48.1%) had participated in competitions 2 or 3 times, most of the subjects (63.4%) had only joined one soccer club.

Table 1: Socio-demographic characteristics of the subjects

Keterangan	Numbers	%
Origin/Tribe		
Javaness	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 (year)		
12-15	90	68.7
15-19	41	31.3
Total	131	100.0
Religion		
Muslim	125	95.4
Hindu	2	1.5
Buddhist	1	0.8
Christian	3	2.3
Total	131	100.0
Period joined in the team (year)		
0-4	96	73.3
5-8	24	18.3
9-12	11	8.4
Total	131	100.0
Frequency of competition participation (time/week)		
0-1	34	25.9
2-3	63	48.1
4	34	26.0
Total	131	100.0
Football club participation		
0-1	83	63.4
2-3	43	32.8
4-5	5	3.8
Total	131	100.0

NTB: Nusa tenggara barat (West nusa tenggara), NTT: Nusa tenggara timur (East Nusa tenggara)

Table 2: Characteristics of subjects' medical history and habits

Keterangan	Numbers	%
Allergy		
Yes	14	10.7
No	117	89.3
Total	131	100.0
Smoking habit		
Yes	10	7.6
No	121	92.4
Total	131	100.0
Alcohol consumption		
Yes	13	9.9
No	118	90.1
Total	131	100.0
Caffeine consumption		
Yes	118	90.1
No	13	9.9
Total	131	100.0
Supplement use		
Yes	44	33.6
No	87	66.4
Total	131	100.0
Sleeping time (h/day)		
6-8	103	78.6
8,5-10	22	16.8
>10	6	4.6
Total	131	100.0
School time (h/day)		
3-4	87	66.4
4,5-5	43	32.8
>5	1	0.8
Total	131	100.0

Descriptive data: The characteristics of the subjects' medical history and habits are presented in Table 2. As seen, most of the subjects (89.3%) do not suffer from allergies. The majority (92.4%) of the subjects do not smoke or consume alcohol (90.1) or caffeine (90.08), 66.4% of the subjects do not use supplements. Most of the subjects (78.6%) sleep 6-8 h per day time and 66.4% attend school 3-4 h a day.

Analysis of all predictor variables to performance: As seen in Table 3, the correlation test results show the magnitude of the significant relationship between the athletes' performance and the predictor variables, which consist of exercise, heart rate, systolic and diastolic blood pressure, cholesterol, hematocrit and hemoglobin levels, mesomorph and ectomorph body types, intake of energy, protein, fat, carbohydrates, fluid intake, height for age, BMI for age, arm muscle, weight, BMR, BMI and height.

After the correlation test, further analysis was conducted by controlling for exercise. The correlation test results evaluating the influence that all the predictor variables have on performance and are not different from the results obtained when analyzing the impact of uncontrolled exercise (r = 0.731). Protein intake becomes a significant factor related to performance when exercise is considered (p = 0.007). This finding relates to the social status of athletes, elite athletes have a higher perception of the need to consume more protein (Table 3).

Table 3: Double correlation test of the impact of independent variables on performance

Variables	Significant	Significant**	r-value
Anthropometric			
Body weight	0.000*	0.002	0.407
Body height	0.000*	0.002	0.423
Body fat	0.343	0.496	0.455
BMR	0.000*	0.001	0.479
BMI	0.000*	0.018	0.480
Fat-whole body	0.915	0.910	0.486
Fat-trunk	0.717	0.850	0.487
Fat-arm	0.943	0.946	0.501
Fat-leg	0.840	0.977	0.018
Muscle-whole body	0.687	0.967	0.038
Muscle-arm	0.003*	0.065	0.456
Muscle-leg	0.611	0.510	0.457
Mesomorph	0.173*	0.435	0.491
Ectomorph	0.086*	0.246	0.494
BMI for age	0.049*	0.229	0.496
Height for age	0.000*	0.019	0.541
Biochemical			
Fasting blood glucose	0.853	0.820	0.016
Uric acid	0.903	0.951	0.019
Cholesterol	0.082*	0.182	0.154
Hemoglobin	0.037*	0.031	0.213
Hematocrit	0.034*	0.024	0.219
Hydration status			
Body weight change	0.502	0.495	0.609
Clinical			
Sistole	0.000*	0.000	0.545
Diastole	0.017*	0.122	0.552
Heart rate	0.001*	0.000	0.591
Nutrition intake			
Energy	0.000*	0.008	0.515
Fat	0.000*	0.007	0.518
Protein	0.103*	0.007	0.519
Carbohydrate	0.000*	0.001	0.486
Fluid intake	0.000*	0.050	0.418
Smoking	0.733	0.860	0.610
Alcohol	0.407	0.129	0.627
Caffeine	0.581	0.899	0.629

*Followed by regression test, significant at $p<0.05$, **Correlation test by controlling exercise factor

Regression analysis was then conducted to determine the impact that the variables (weight, height, BMR, BMI, arm muscle, mesomorph and ectomorph body types, BMI for age, height for age, cholesterol, hemoglobin and hematocrit levels, systolic and diastolic blood pressure, heart rate, energy intake,

Table 4: Correlation analysis of the impact of all predictor variables on VO2 max

Dependent variables	r-value	Significant
VO2 max	0.698*	0.000
VO2 max	0.706**	0.000
VO2 max	0.725***	0.000

*Without considering smoking, alcohol, caffeine, exercise frequency, **Considering smoking, alcohol, caffeine, ***Considering smoking, alcohol, caffeine, exercise frequency

carbohydrate, protein, fat and liquid intake) have on VO2 max (Table 4). As seen in Table 4, all the variables have a significant impact on VO2 max (p = 0.00) with r = 0.698, if smoking habits, alcohol and caffeine consumption and exercise are neglected. The variables that have a significant impact on VO2 max after the regression analysis are ectomorph body type, BMI for age, heart rate and fluid intake.

As seen in Table 5, the r-value increases (r = 0.706) when smoking habits and alcohol and caffeine consumption are considered. The r-value increases (r = 0.725) by adding the exercise factor. It can be concluded that nutrition has a 69.8% impact on an athlete's performance when smoking habits, alcohol and caffeine consumption and exercise are not considered, 31.2% of the impact on performance can be explained by the other factors. When other factors, such as exercise, are considered the impact of nutritional status and exercise on VO2 max increases to 72.5. On its own, exercise only has 2.7% impact on VO2 max.

DISCUSSION

The correlation analysis results show that the independent variables that have a significant impact on VO2 max in athletes are exercise, heart rate, systolic blood pressure, diastolic blood pressure, cholesterol, hematocrit and hemoglobin levels, mesomorph and ectomorph body types, intake of energy, protein, fat and carbohydrates, fluid intake, height for age, BMI for age, arm muscle, weight, BMR, BMI and height. The regression analysis results show that, of all the variables presented above, nutrition status has the greatest impact (69.8%) on an athlete's performance, the most significant variables are ectomorph body type, BMI for age, heart rate and fluid intake. When lifestyle variables (alcohol and caffeine consumption and exercise) are added, the impact of nutrition on performance increases to 72.5%.

Affect of independent variables on VO2 max: The correlation test results presented in Table 3 show that anthropometric variables, such as weight, height, BMR, BMI, arm muscle, BMI for age and height for age, have a significant impact on the performance parameters of VO2 max. Previous research studies have reported the relationship between anthropometric profiles and an athlete's performance[9]. Height and BMI are significantly associated with VO2 max in adolescent soccer athletes[9]. Yet, height also relates to altitude while performing a vertical leap test and sprint times for distances of 10 and 30 m. The BMI is associated with the speed of shooting the ball and sprint time at a distance of 30 m. An adolescent soccer athlete's weight has been found to be significantly associated with performance as seen in VO2 max values[10]. While another study found that the percentage of body fat is associated with an athlete's performance, the result was not statistically significant[11].

Moreover, research on elite athletes in Serbia reported a positive relationship between VO2 max and maximum systolic blood pressure and maximum heart rate (HRmax). In another study, a negative correlation was found between VO2 max and maximum diastolic blood pressure[12]. Endurance athletes experience increased plasma volume, followed by a decrease in Hb and Hct. This occurs in response to long-term exercise. Changes in the hemoglobin and hematocrit biochemical indicators have been found to affect an athlete's physical performance[13]. The hematocrit level is associated with an athlete's hydration status. In an athlete who is dehydrated, the hematocrit level will increase due to decreased plasma volume[14]. Losing body fluids, which is caused by dehydration, has been found to decrease an athlete's performance[15].

An athlete needs carbohydrate intake as glycogen stored in muscles. Sufficient muscle glycogen will increase an athlete's endurance, which can improve performance[16]. Research conducted on adolescent basketball athletes reported that there is a relationship between protein intake and muscle strength[17].

Affect of the nutrition and lifestyle variables on VO2 max: As seen in Table 5, the BMI for age, ectomorph body type, heart rate and fluid intake variables are the main factors that affect VO2 max when smoking habits, alcohol and caffeine consumption and exercise are not considered. However, Model 2 shows that the BMI for age, heart rate and fluid intake variables are the main factors that affect VO2 max when smoking habits and alcohol and caffeine consumption variables are considered. Model 3 shows that the BMI for age, ectomorph body type, heart rate and exercise variables are the main factors that influence an athlete's VO2 max. The combination of these models indicates that the BMI for age, ectomorph body type, heart rate, fluid intake and exercise variables affect VO2 max. The r-value in Model 2 is greater than the r-value in Model 1 due to the impact of smoking

Table 5: Multiple regression test results of the impact of predictor variables on VO2 max

		B			Standard errors			T			Significant		
Variables	Models	1	2	3	1	2	3	1	2	3	1	2	3
	Constant	51.536	62.614	85.128	61.828	63.114	62.315	0.834	0.992	1.366	0.40	0.32	0.17
Anthropometric	Body weight	-0.149	-0.161	-0.041	0.244	0.246	0.245	-0.612	-0.654	-0.167	0.54	0.51	0.86
	Body height	0.276	0.254	0.157	0.368	0.379	0.373	0.749	0.670	0.421	0.45	0.50	0.67
	BMR	-0.005	-0.005	0.002	0.018	0.018	0.018	-0.275	-0.277	0.108	0.78	0.78	0.91
	BMI	-0.228	-0.238	-1.501	1.153	1.200	1.278	-0.198	-0.198	-1.174	0.84	0.84	0.24
	BMI for age*	-7.718	-7.624	-6.534	3.177	3.221	3.177	-2.429	-2.367	-2.057	0.01*	0.02*	0.04*
	Height for age	2.171	2.313	2.107	2.713	2.750	2.687	0.800	0.841	0.784	0.42	0.40	0.43
	Muscle arm	0.168	0.009	-0.154	0.520	0.537	0.529	0.323	0.017	-0.291	0.74	0.98	0.77
	Mesomorph	1.033	1.106	1.406	0.948	0.967	0.953	1.090	1.143	1.476	0.27	0.25	0.14
	Ectomorph*	-6.676	-6.405	-6.305	3.327	3.376	3.298	-2.007	-1.897	-1.912	0.04*	0.06	0.05*
Biochemical	Cholesterol	0.013	0.021	0.029	0.026	0.027	0.027	0.514	0.752	1.078	0.60	0.45	0.28
	Hemoglobin	-2.190	-2.114	-4.444	3.610	3.663	3.699	-0.607	-0.577	-1.201	0.54	0.56	0.23
	Hematocrit	0.813	0.770	1.497	1.194	1.211	1.219	0.681	0.635	1.228	0.49	0.52	0.22
Clinical	Sistole	0.089	0.070	0.073	0.058	0.060	0.059	1.538	1.167	1.239	0.12	0.24	0.21
	Diastole	-0.026	-0.008	0.000	0.080	0.081	0.080	-0.325	-0.095	-0.005	0.74	0.92	0.99
	Heart rate*	-0.099	-0.102	-0.107	0.052	0.052	0.051	-1.905	-1.950	-2.091	0.05*	0.05*	0.03*
Nutrition intake	Energy	0.003	0.004	0.000	0.003	0.003	0.004	0.979	1.088	-0.097	0.32	0.27	0.92
	Protein	0.006	0.005	0.045	0.038	0.039	0.041	0.166	0.126	1.094	0.86	0.90	0.27
	Fat	-0.008	-0.002	0.036	0.068	0.068	0.068	-0.111	-0.034	0.531	0.91	0.97	0.59
	Carbohydrate	-7.025	-7.108	-5.982	3.845	3.937	3.872	-1.827	-1.805	-1.545	0.07	0.07	0.12
	Fluid intake*	0.001	0.001	0.001	0.001	0.001	0.001	2.267	2.283	1.729	0.02	0.02*	0.08
Other factors	Smoking		-1.881	-1.604		1.760	1.723		-1.069	-0.931		0.28	0.35
	Alcohol		1.974	1.900		1.621	1.584		1.218	1.199		0.22	0.23
	Caffeine		-1.025	-0.807		1.399	1.369		-0.733	-0.589		0.46	0.55
	Exercise*			0.463			0.187			2.479			0.01*

*: Significant results ($p<0.05$), B: Regression coefficient result, T: Partial analysis results, 1: Without considering smoking, alcohol, caffeine, 2: Considering smoking, alcohol, caffeine, 3: Considering smoking, alcohol, caffeine, exercise frequency, BMR: Basal metabolism rate, BMI: Body mass index

habits and alcohol and caffeine consumption. The r-value in Model 3 is greater than the r-value in Model 2 because the exercise variable was added. Interpretation of the results indicate that higher consumption of cigarettes (smoking habits) and alcohol and caffeine consumption have a significant impact on an athlete's VO2 max. However, several factors still need to be considered. According to the analysis, total consumption of cigarettes is approximately takes one butt per day. If the consumption of alcohol and caffeine is low, then the effect on VO2 max is not found. A study investigating the impact of lifestyle on the performance of youth football athletes reported a positive relationship between smoking and alcohol consumption and VO2 max[18]. The average number of cigarettes smoked is still one butt per day but the effect has not yet been determined.

Anthropometric variables and VO2 max: The regression test results for the impact of the anthropometric variables on athletic performance show that, for somatotype, BMI for age and ectomorph body type are the most significant variables. It has been found that an athlete's performance is not significantly affected by BMI[18], which is in agreement with the findings of the present study that BMI does not affect an athlete's performance. When BMI is corrected for age, the statistical test results show that the BMI for age variable can significantly affect VO2 max. The Statistical Package for the Social Sciences (SPSS) test results showed that the impact of BMI for age on VO2 max was negative, whereas a high BMI for age value can decrease the VO2 max value.

A decrease in the BMI for age value increases the VO2 max value to 77 mL kg^{-1} min^{-1}. However, when smoking and alcohol and caffeine consumption are considered, the impact of BMI for age on VO2 max is increased to 6.5 mL kg^{-1} min^{-1}. A decrease in ectomorph component will increase the VO2 max value to 6.7 mL kg^{-1} min^{-1}. It means that the body should be changed into more dense of bones and muscles, while the body height still need to be considered. Caffeine and alcohol consumption, smoking and exercise do not have a significant impact on the VO2 max (6.3 mL kg^{-1} min^{-1}). However, a decrease in the heart rate will affect an athlete's performance. A lower heart rate indicates a better performance. The results presented in Table 5 show that decreasing the heart rate increases the VO2 max value to 0.01 mL kg^{-1} min^{-1}. This effect increases with exercise (0.107 mL kg^{-1} min^{-1}). Increasing fluid intake affects VO2 max, without the presence of any other variables. This means that fluid intake is a significant factor for avoiding dehydration and supporting an athlete's performance. Exercise also has a positive effect on performance; any increase in physical exercise will increase the VO2 max value by 0.5 mL kg^{-1} min^{-1}.

Body composition and somatotype are variables that affect an athlete's performance. In sports, different positions require a specific body type in order to achieve maximum performance. Athletes in Bangladesh were reported to have more muscle mass than fat mass[19]. Nutritional status and suitable body proportions are shaped by engaging in exercise and consuming an appropriate diet. Both factors will change body composition. Exercising and eating an appropriate diet decreases the percentage of fat and increase muscle mass[20]. Research conducted on American football athletes in New Mexico has shown that for receivers, a low BMI and a low percentage of body fat results in maximum performance[20]. This provides evidence that a fit body contributes to a good performance. However, that study found no relationship between somatotypes and an athlete's position and performance. The VO2 max is a physiological function that serves as an indicator of an athlete's performance level[21]. A study conducted on men ranging from 18-22 years of age reported a negative correlation between BMI and VO2 max[22]. The VO2 max value will decrease in overweight or obese people because the high proportion of fat mass affecting the muscle fails to take sufficient oxygen, thereby decreasing aerobic capacity[23]. The decrease in VO2 max in people with a higher BMI has also been reported in a study conducted in India. Changes in VO2 max value were significant when the nutritional status changed from normal to overweight and even obesity[24]. An ectomorph body type has less fat (fat-free weight) and less body mass (body cell mass) than mesomorph and endomorph body types[25]. Soccer athletes can be classified as having an mesomorphic ectomorph somatotype (2.06-4.35-2.60)[26]. Having an ectomorph somatotype is important for soccer athletes. Soccer is dominated by extreme activities that require athletes to have strong bones in their lower limbs[27]. Therefore, having an ectomorph somatotype helps improve a soccer athlete's performance. A dominant ectomorphic composition enables athletes to achieve maximum VO2 consumption and a high respiratory exchange ratio (RER) when engaging in peak physical activities[25]. Athletes with a dominant ectomorph somatotype have an advantage because it positively correlates to output power, ventilator rate, oxygen consumption and heart rate. The working capacity test results show that people with a dominant ectomorph somatotype have different physiological responses. Glycolytic metabolism increases as evidenced by increases in RER and lactate concentration after engaging in exercise. Ectomorph response to the respiratory system shows that the ventilatory equivalent for oxygen value is higher in people with this somatotype, which indicates an increase in the oxygen uptake rate.

Heart rate and VO2 max: A study shows that there is a correlation between aerobic capacity and heart rate ($r = -0.904$, $p<0.005$)[28]. During physical activity, the heart rate increases accompanied by a decrease in aerobic capacity. The VO2 max is affected by systolic blood pressure, maximum heart rate (HRmax) and heart rate reserve (HRR, the gap between HRmax and HRR in the break). These three components are positively correlated with VO2 max. Diastolic blood pressure is negatively correlated with VO2 max. The autonomic nervous system plays a role in modulating heart rate and blood pressure[28].

At rest, the heart rate is lower in trained athletes than laymen. However, athletes with abnormal blood pressure have a higher heart rate while resting[12]. An athlete's cardiovascular response to exercise is shown by increases in systolic blood pressure and heart rate. The response of the sympathetic nervous system increases cardiac output. However, diastolic blood pressure does not change significantly when peak exercise output is reached[29].

Exercise factor and VO2 max: A meta-analysis of 41 studies on exercise and VO2 max found that VO2 max increases after physical exercise for a specific time duration. The average time required to increase VO2 max is 20 weeks when engaging in physical exercise 3 times a week. The differences in the results of a VO2 max test among athletes who use more than 70% VO2 max and athletes who use 60-65% VO2 max were not statistically significant[30]. However, moderate exercise (50% VO2 max) vigorous exercise (75% VO2 max) and near maximum exercise (95% VO2 max) were found to significantly increase VO2 max after 4 weeks of intervention, near maximum exercise (95% VO2 max) had a more significant impact on increasing VO2 max than moderate exercise (50% VO2 max) or vigorous exercise (75% VO2 max)[31].

A study conducted in Semarang, Indonesia reported that aerobic exercise (400 m <130 sec for 12 weeks, 3 times/week) significantly increased VO2 max before and after intervention[32]. In addition, the results of a VO2 max test between the control and treatment groups at the end of the intervention also showed that the VO2 max value in the treatment group was higher. In addition to aerobic exercise, weight training can increase oxygen consumption per minute and it can increase cardiorespiratory function. Programmed physical exercise (duration, intensity and frequency) can increase VO2 max in adolescent athletes after 12 weeks of intervention[33].

There was a significant difference between the increases in VO2 max before and after the intervention in the experimental group, the VO2 max was significantly higher in the treatment group than the control group[33].

There is a significant relationship between physical activity and VO2 max in soccer athletes[18]. To increase VO2 max, physical activity with 72-87% intensity is recommended. Moderate exercise is not an optimal way to increase VO2 max and it can increase the induction of Ca ions in cardiomyocytes. The increase in Ca ions affects the contradiction of the cardiomyocytes and results in hypertrophy. Exercise that uses less than 100% VO2 max has a more significant effect than exercise that uses more than 120% VO2 max[34].

Fluid intake and VO2 max: An athlete's fluid intake also affects VO2 max. Water is the main component in the body and the balance of total body fluid is regulated by fluid entry and fluid exit. The main objective of this regulation is to ensure a proper amount of fluid in the cells under normal conditions in order to maintain homeostasis. Sweat is the secretion of plasma that contains more water than electrolytes. Excessive sweat increases the concentration and osmolality of blood sodium levels. The hypothalamus addresses these changes by producing hormones and triggering thirst. In accordance with the desire to drink, exercise performance will not be optimal because the main control in the body is disturbed not only to control activities but also to control thirst[35].

In 2007, the American College of Sports Medicine declared that, in an athlete, dehydration is indicated by a weight loss >2%, which disrupts aerobic performance. The author provides some suggestions for how to maintain hydration during exercise, especially endurance exercise[36]. First, be sure to be properly hydrated before engaging in exercise, second, drink when thirsty and third, restrict fluid consumption 1 h before exercising. In addition, the types of beverages consumed while exercising can affect an athlete's VO2 max[36]. Athletes who are given low-fat milk have a higher VO2 max level than athletes who are given a commercial sports drink. The nutrient content in the type of beverage and the amount of fluid consumed can also affect an athlete's VO2 max[37-39].

CONCLUSION

Nutritional factors (69.8%) were found to have the greatest impact on an athlete's performance are: BMI for age, ectomorph body type, heart rate and fluid intake. Exercise and nutritional factors were found to have a 72.5% impact on an athlete's performance. Based on the study's findings, athletes, coaches and sports officials should be aware of the nutritional status of each player because it has a significant impact on an athlete's performance. The limitation of the study is that the research is based on youth athletes that play football, therefore, nutrition and lifestyle might have a different impact on an athlete's performance in other types of sports.

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