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Comparison of somatotype profiles and dietary intake of football athletes in different playing levels in Indonesia

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ABSTRACT

Background: *Anthropometry characteristic was significantly correlated with nutrition status, and both factors significantly contributed to athletes' sports performance. Somatotype as one of the anthropometric values can be used as screening or "diagnosis" in selecting new talents. The changes in athletes' body composition by inadequate dietary intake and over-consumption relate to the performance quality of athletes.* ***Objective:*** *The study aimed to compare football athletes' somatotype profiles and dietary intake in different playing levels in Indonesia.* ***Methods:*** *A total of 112 adolescent football athletes in 4 playing levels; elite national team (ENT), advanced senior team (AST), advanced junior team (AJT), and amateur college athletes (ACT), performed somatotype measurement and dietary intake assessments using 3x24-h food recall. One-way analysis of variance (ANOVA) was conducted to illustrate the difference among ENT, AST, AJT, and ACT groups, while a post-hoc test was used to verify pairwise comparison.* ***Results:*** *All groups showed a significant difference in somatotype profiles and dietary intake. The somatotype profile of ENT group, categorized as balanced mesomorph (2.5-5.2-2.2), was the closest to the ideal profile of elite football athletes and was the most mesomorph among other groups. The somatotype of the AST group was the least mesomorph (1.5-3.2-3.0). Adequate energy intake was found only in the ENT group, whereas inadequate (<80%) in other groups. None of the groups consume an adequate amount of carbohydrates. The lowest dietary intake was found in the lowest playing level group, ACT. The somatotype profile and dietary intake of the ENT group were the most optimum compared to other groups, although the excess intake of fat should be noticed.* ***Conclusions:*** *The somatotype profile of elite athletes in the ENT group was the closest to the ideal somatotype of elite football athletes in high-level competition. Dietary intake in the ENT group was also the most adequate, although the excess fat intake should be noticed.*

KEYWORDS: *anthropometry; athlete; body composition; football; nutrition status; somatotype*

INTRODUCTION

Somatotype is classification of body size and proportion for someone physique [1]. The identification of somatotype as one of the anthropometric values and the nutrition intake of athletes is essential because its strong relation to the performance quality of athletes. Study by Penggalih *et al.* in youth football athletes reported that anthropometry characteristic was significantly correlated with nutrition status, and both factors were significantly contributed on the sports performance of athletes [2]. Somatotype can be used as screening or "diagnosis" in selection of new talents [3]. Players from successful team tend to have more muscular and leaner physique than from unsuccessful teams [4]. Moreover regular examination somatotype of soccer player can help coaches to determine training program that would be improve athlete sports performance [5].

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The changes of athletes' body composition and body weight are led by inadequate dietary intake and over-consumption [6]. That changes which may come as a result of the inadequate or over-consumption may have an adverse impact on the athletes' ability to perform and sustain activity during competition and in-season. Football athletes need to continuously refueling their energy reserves especially during training and competition as their energy stores may not be enough for a longer period. Besides, the maintenance of energy balance through adequate energy consumption is necessary to accomplish right consumption of essential macro-and micro-nutrients for the athletes [7].

The main nutrient required for football athletes is carbohydrates protein. It is recommended that football athletes consume about 7 - 10 g/kg of body weight for carbohydrates and 1.2 - 1.7 g/kg of body weight for protein since the contribution of proteins to the production of energy is low. It is also recommended that athletes consume about 20% - 35% of their total daily energy requirement from fat [8]. The recommend intake of carbohydrates is adequate for maintaining plasma glucose levels and replenishing muscle glycogen stores while the protein intake is also adequate for supporting nitrogen balance, sparing amino acids for protein synthesis and for maintaining optimum performance [9]. It stated that inadequate dietary intake will lead to low levels of cortisol and reduced activities of the antioxidant enzymes, high cell damage which may result in reduced athletes' performance and injuries [10]. However, previous researches have reported that football athletes across various level of competition generally fail to meet energy and carbohydrate recommendation [11-13].

Studies relate to somatotype and dietary of football athlete at different level in Indonesia are poorly explored. Somatotype profile and dietary intake of football athletes in different level of competition in Indonesia might be heterogeneous because each level of competition have various training routines that may resulted in different total training volume which affected body composition. Besides, each level may not have similar meal preparation at their living dorm or house, which also contributed in the difference of nutrition intake and somatotype values. This study aimed to describe the comparison of somatotype and nutrition intake of football athletes in four different playing levels. This comparison will help to assume in which level the athletes have the best nutrition intake and somatotype values.

METHODS

Study design and participants

This is a cross-sectional study using secondary data taken from previous studies which examined the somatotype and dietary intake of youth football athletes (15-23 years old) in Indonesia. Data of somatotype and dietary intake of 112 athletes were taken from 3 studies [14-16]. This study used total population sampling to take the whole measurement data of athletes' somatotype and dietary intake from the selected studies. Inclusion criteria for data selection were youth football athletes (15-23 years old) and registered as an active member of public or private sport school/club in Indonesia. Incomplete data, or the absence of either the somatotype or dietary intake measurement was excluded. The athletes were categorized into four groups based on their level of competition and training load: 1) Elite National Team (ENT); 2) Advanced Senior Team (AST); 3) Advanced Junior Team (AJT); and 4) Amateur College Team (ACT).

The athletes in Elite National Team (ENT) group (n=30) was National Football Team of Indonesia for under 19-year-old group (U-19) in 2014. Athletes in this group were selected from entire regions in Indonesia to play in national team and were staying in national camp during data collection period. ENT athletes received prepared meal with standardized portion for each individual by nutritionist. ENT athletes undergone 2x6 days/week training.

The Advanced Senior Team (AST) group was football athletes (n=24) in the Ragunan School of Sports managed by Ministry of Youth and Sports Republic of Indonesia. The athletes, aged 15-18 years old, were selected and were trained to compete further selection for Indonesia national team or to enroll in professional football clubs. AST athletes were living in athlete's dormitory with scheduled training, study, and meals. Training frequency in AST group was 2x5 days/week. Athletes received prepared meal in school cafeteria with no individualized portion.

Advanced Junior Team (AJT) was a group of football student athletes (n=28), aged 15-18 years old, in a private football school Aji Santosa International Football Academy (ASIFA), Malang, Indonesia. AJT athletes were living in athlete's dormitory and received 1x5 days/week training routines and individualized meals. AJT athletes competed in inter-football school competitions and were trained to pursue professional career in football clubs or national leagues.

Amateur College Team (ACT) group consisted of amateur college athletes (n=30) who competed in 2016 College Football League in Yogyakarta. Age of athletes in ACT group was ranged from 19-23 years old. The athletes were active college students in several universities in Yogyakarta, Indonesia. Athletes in this group had individual living, unscheduled training routines, and did not received any specific nutrition intervention.

The whole process of data collection was conducted under the ethical approval by Ethic Committee of Faculty of Medicine, Universitas Gadjah Mada, Yogyakarta, Indonesia. Data collection for ENT group was performed in Jakarta, 2014, with reference code of ethic: KE/FK/658/EC (14). Assessment for AST and AJT groups was performed in Jakarta and Malang, Indonesia, in 2016 with reference code of ethic: KE/FK/02/EC/2016 [15]. Data collection for ACT group was conducted in Yogyakarta, Indonesia, in 2017 with reference code of ethic: KE/FK/0504/EC/2017 [16]. The use of data for this paper has obtained approval from the respective authors.

Measures

Somatotype measurements. The anthropometric measurements were conducted using standard instruments and methods in accordance with the guideline by the International Society for the Advancement of Kinanthropometry (ISAK). The somatotype was calculated using Heath-Carter Method by measuring 10 anthropometric dimensions: height (in centimeters), body weight (in kilograms), 4 skinfolds (triceps, subscapular, supraspinale, and medial calf, in milimeters), 2 limb girths (flexed arm and calf, in centimeters), and 2 bone breadth (bioepicondylar humerus and femur, in centimeters). Body weight and height were measured in light clothes using electronic scale (OMRON HN289) to the nearest 0.1 kg and portable stadiometer (GEA Stature Meter SH2A) to the nearest 0.1 cm. Lange skinfold caliper (Beta Technology Inc,USA) was used to measure skinfolds, measurement tape (ABN metline) for limb girths, and Meiden wide-spreading caliper for bone breadth.

All anthropometric measurements were performed by well-trained measurement team. Every measurements were taken three times and the mean was used for data analysis. Somatotype value was calculated using Heath Carter Formula as follow:

Endomorphy = -0.7182 + 0.1451 (X) - 0.00068 $(X)^2$ + 0.0000014 $(X)^3$

X = (sum of triceps, subscapular, and supraspinale skinfolds) × (170.18/height)

Esomorphy = [0.858 × humerus width (cm)] + [0.601 × femur width (cm)] + [0.188 × (arm girth - triceps skinfolds (cm))] + [0.161 × medial calf girth medial calf skinfolds (cm)] - (0.131 × height) + 4.5

Ectomorphy was calculated using one of the following formula:

If HWR ≥ 40.75, ectomorpy = 0.732 HWR - 28.58

If HWR ≤ 40.75 but >38.25, ectomorphy = 0.463 HWR - 17.63

If HWR ≤ 38.25, ectomorphy = 0.1

*

HWR = height/$\sqrt[3]{\text{weight}}$

Once the value of endomorphy, mesomorphy, and ectomorphy were calculated, the somatotype was categorized into one of the thirteen [13] somatotype categories: central, balanced endomorph, mesomorphic endomorph, mesomorph-endomorph, endomorphic mesomorph, balanced mesomorph, ectomorphic mesomorph, mesomorph-ectomorph, mesomorphic ectomorph, balanced ectomorph, endomorphic ectomorph, endomorph-ectomorph, and ectomorphic endomorph [17].

Dietary intake measurements. Evaluation of dietary intake was determined using 3x24-hour food recall. Dietary recall was conducted on 2 non-consecutive weekdays and 1 weekend day. Nutrition intake was compared to nutrition requirement of each athletes which was calculated based on their basal, daily activities, and specific training's energy. Basal energy was determined by Karada Scan Body Impedance Analysis, corrected by age and sex. Specific training's energy was determined from the calculation of energy expenditure according to each duration, type, and frequency of training. Analysis of dietary intake was taken using Nutrisurvey software, version 2007. People whose intake fulfill at least 90% of recommended daily intake are labeled as good or adequate, less than 70% means severe, 70% to 80% implies moderate, and 80% to 90% is classified as mild deficient [18].

Data analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS, version 16.0, SPSS Inc, Chicago, IL, USA). Data normality was checked by Kolmogorov-Smirnov test. One-way analysis of variance (ANOVA) was conducted to illustrate the difference among ENT, AST, AJT, and ACT group while post-hoc test was used to verify pairwise comparison. The level of significant was set at $p<0.05$.

RESULTS

The athletes, aged 15-23 years old, were categorized into four groups based on their level of competition and training load: 1) Elite National Team (ENT); 2) Advanced Senior Team (AST); 3) Advanced Junior Team (AJT); and 4) Amateur College Team (ACT) (**Table 1**). Football athletes participated in the study were aged from 15-19 years old and the average age was 15.8 years old. Athletes in ENT, AST, and AJT group were 10^{th}-12^{th} graders of high school while athletes in ACT group were college students in their 1^{st}-4^{th} year of study. ENT athletes competed 1-2x/month in trial matches and 1-2x/year in national league. AST and AJT groups played in trial matches 1x/month and 3-4x/year in regional-level leagues, while ACT competed in 2-3 regional matches/year.

As shown in **Table 2**, the average height of ENT group (172.4±6.0 cm) was the highest among three other groups. Average body weight of ACT group was the lowest with 60.6±7.9 kg. Compared to other groups, the somatotype measurement indicated that AST group had the smallest value of endomorph (1.5±0.3) and

Table 1. Characteristics of subject

Category	Club/team	n	Age (years old)	Training frequency (days/week)	Level of competition	Dietary program	Publication
Elite National Team (ENT)	Indonesia National Football Team U-19	30	16-19	2x6	International	Meals prepared by nutritionist	(14)
Advanced Senior Team (AST)	Football Team of Ragunan Sports School	24	15-18	2x5	National	Individualized meal portioning in school cafetaria	(15)
Advanced Junior Team (AJT)	Aji Santosa International Football Academy (ASIFA) Malang	28	15-18	1x5	Regional	Individualized meal portioning in dormitory	(15)
Amateur College Team (ACT)	Football teams in College Football League Yogyakarta 2016	30	19-23	tentative	Regional (amateur)	Individual living	(16)

Table 2. Somatotype value of football athletes in four different playing levels

	ENT (n=30)	AST (n=24)	AJT (n=28)	ACT (n=30)
Body weight (kg)	66.9 ± 6.8	64.1 ± 7.6	62.1 ± 7.5	60.6 ± 7.9
Body height (cm)	170.4 ± 5.7	172.4 ± 6.0	170.8 ± 5.1	167.6 ± 5.7
Endomorph	2.5 ± 0.4^{e}	$1.5 \pm 0.3^{a,b,c}$	$3.0 \pm 0.8^{d,e}$	2.1 ± 0.6
Mesomorph	5.2 ± 0.7	$3.2 \pm 0.7^{a,b,c}$	4.2 ± 0.9^{d}	4.5 ± 1.2
Ectomorph	2.2 ± 0.6	3.0 ± 0.9^{b}	3.1 ± 1.0^{d}	2.8 ± 1.5
Somatotype Category	Balanced mesomorph	Ectomorph-mesomorph	Balanced mesomorph	Ectomorphic mesomorph

Significant difference was set at $p<0.05$, which compared the following pairs: ^{a} AST-AJT; ^{b} AST-ENT; ^{c} AST-ACT; ^{d} AJT-ENT; ^{e} AJT-ACT; ^{f} ENT-ACT mesomorph (3.2±0.7). **Table 3** describe the frequencies of somatotype category based on level of competition. It can be shown that ENT group has the smallest diversity of somatotype categories, while the other level group of competition have more variety of somatotype.

Table 4 conclude the categories of somatotype based on position each group. There were 4 positions, dependers, midfielders, goalkeepers, and forwards. It can be seen that the somatotype category in the senior group (ENT, SNT) is more centralized, while in the other junior group it is more varied (JNT, ANT).

ANOVA analysis of 3x24 hours dietary intake illustrated in **Table 5** showed that respective group is significantly different with p-value <0.05 (0.000*). The percentage of energy, protein, fat, and carbohydrate intake in ENT group was the highest among all. Interestingly, energy intake of ENT and AST groups are distinguishable respectively, while AJT and ACT group showed comparable result. Protein intake of ENT reveals differentiable results of whole groups, whereas the other three present resemble data. Hereafter, ACT is less likely to consume fat in comparison with AJT, proven by markedly unalike data. Yet, both the advanced teams showed considerably homogeneous intake. Intriguingly, carbohydrate intake in all groups was found to be inadequate (<90%) with ENT's intake showed the least gap to adequate recommendation.

DISCUSSION

Somatotype is the basic classification of physical characteristics and body type. Three components of classical anthropometric somatotype are relative fatness (endomorph), musculoskeletal (mesomorph), and linearity (ectomorph) [19]. Although mesomorph was found to be dominant in all group in the recent study, the somatotype scores were not homogeneous. Somatotype of ENT group was categorized in balanced mesomorph, and they had the highest mesomorph score with its overall score (2.5-5.2-2.2) was the closest to somatotype scores of

Table 3. Categories of somatotype based on playing level

Categories of somatotype	Groups (%, n)			
	ENT	SNT	JNT	ANT
Balanced ectomorph	-	4 (1)	-	3.3 (1)
Balanced mesomorph	47 (14)	12 (3)	21.5 (6)	20 (6)
Central	-	4 (1)	21.5 (6)	-
Ectomorphic mesomorph	17 (5)	20 (5)	3.6 (1)	13.2 (4)
Endomorphic mesomorph	36 (11)	-	21.5 (6)	29.7 (9)
Mesomorph – ectomorph	-	48 (11)	3.6 (1)	9.9 (3)
Mesomorph – endomorph	-	-	10.8 (3)	-
Mesomorphic ectomorph	-	12 (3)	17.5 (5)	23.1 (7)
Total	100 (30)	100 (24)	100 (28)	100 (30)

Table 4. Categories of somatotype based on position each group

Categories of somatotype	Dependers (%)				Midfielders (%)				Goalkeepers (%)				Forwards (%)			
	ENT	AST	AJT	ACT	ENT	AST	AJT	ACT	ENT	AST	AJT	ACT	ENT	AST	AJT	ACT
Balanced ectomorph	-	-	12.5	-	-	11	-	12.5	-	-	-	-	-	-	-	-
Balanced mesomorph	60	-	-	25	35.7	11	37.5	25	33.3	-	-	-	66.7	33.4	33.2	22.2
Central	-	20	12.5	-	-	-	-	-	-	-	66.6	-	-	-	16.7	-
Ectomotphic mesomorph	20	40	-	-	21.4	22	-	25	-	25	-	-	-	-	16.7	22.2
Endomorphic mesomorph	20	-	25	62.5	42.9	-	25	-	66.7	-	16.7	60	33.3	-	16.7	11.1
Mesomorph – ectomorph	-	20	-	-	-	45	12.5	-	-	50	-	-	-	66.6	-	55.6
Mesomorph – endomorph	-	-	25	-	-	-	-	-	-	-	16.7	-	-	-	-	-
Mesomorphic ectomorph	-	20	25	12.5	-	11	25	37.5	-	25	-	40	-	-	16.7	11.1
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 5. Percentage of dietary intake compared to daily recommendation intake

Group	Comp. Group	Energy (%)	Protein (%)	Fat (%)	Carbohydrate (%)
ENT (n=30)		97.5 ± 21.1	139.5 ± 38.0	130.9 ± 42.6	78.1 ± 18.1
p-value	AST	0.000*	0.000*	0.878	0.001*
	AJT	0.000*	0.000*	0.000*	0.000*
	ACT	0.000*	0.000*	0.000*	0.000*
AST (n=24)		76.5 ± 14.7	78.5 ± 15.0	124.8 ± 25.0	62.9 ± 15.0
p-value	ENT	0.000*	0.000*	0.878	0.001*
	AJT	0.020*	1.000	0.006*	0.016*
	ACT	0.001*	0.201	0.000*	0.058
AJT (n=28)		63.3 ± 14.3	78.3 ± 21.2	97.0 ± 26.3	50.6 ± 11.3
p-value	ENT	0.000*	0.000*	0.000*	0.000*
	AST	0.020*	1.000	0.006*	0.016*
	ACT	0.780	0.180	0.015*	0.945
ACT (n=30)		59.3 ± 12.8	64.9 ± 16.3	73.0 ± 19.0	52.7 ± 12.8
p-value	ENT	0.000*	0.000*	0.000*	0.000*
	AST	0.001*	0.201	0.000*	0.058
	AJT	0.780	0.180	0.015*	0.945

Note: *significant compared to each group, p-value Post Hoc<0.05

elite or professional football players. The somatotype of Turkish players from the first league is 2.5-4.8-2.3 [19], the elite level of South American footballers is 2.2-5.4-2.2 [20], the elite level of Europe footballers is 2.4-4.8-2.3 [21], and the young elite of Indonesian footballers is 2.7-4.94-2.95 [22]. AJT group was in balanced mesomorph as well, but it was less mesomorphic, more endomorphic and ectomorphic (3.0-4.2-3.1). AST group, which was in higher level than AJT and ACT, unexpectedly had the lowest score of mesomorph, with balanced dominance between mesomorph and ectomorph (1.5-3.2-3.0). Meanwhile, ACT group as the lowest playing level, had the second-highest score of mesomorph with slight dominance of ectomorph over endomorph (2.1-4.5-2.8).

The endomorphic component of somatotype showed significant relationship between body weight and body fat, whereas mesomorph component showed a significant relationship with lean body mass and height. There was a close correlation between body composition and physical performance, such as power strength, speed, and endurance [23]. Body build with dominance in muscle have advantage in sports that needs endurance, speed, and high intensity. Meanwhile, higher endomorphic component which related to adipose tissue would reduce sports performance. Excessive adipose tissue affects energy utilization during exercise that induce early fatigue [19]. Therefore, it can be argued that higher mesomorph, lower endomorph and ectomorph could be advantageous for high intensity and repetitive type intermittent sport, such as football.

Research conducted by Hazir, shows that the overall type of somatotype for players at the senior level is balanced mesomorph in all playing positions [19]. Balanced mesomorph shows the proportion of muscles that are more dominant in the athlete's body. This will provide benefits, namely the athlete's posture becomes stronger and the muscle explosive power is greater. When compared with the results of the research conducted, the results of the study are appropriate where the senior level category has a dominant mesomorphic part. Meanwhile, in the junior competition group, somatotype categories were found which were more varied in each position and in general.

The diversity of somatotype in current study was considered to be influenced by the difference in training load, frequency, and intensity, dietary habit, age, and race or ethnicity of individuals. Intensive training process could change somatotype toward more mesomorph and reduce endomorphism [24]. Consistent and properly planned training routines will positively influence body composition changes and support athlete in building the best somatotype for their sports type and specific playing position. It should be a notice for coaches and athletes in order achieve optimum somatotype profile [25].

As the level of competition increases, athletes are expected to improve their morphology characteristic and physiology aspects as well [19]. Study by Gil *et al* described that age and physical characteristic were essential factors in the selection process for playing athletes during competition [26]. Football has characteristic of long-playing duration and high dynamic and endurance which results in the significantly increase of cardiopulmonary capacity. Aging may reduce athlete's performance capacity, but mature age also indicates wider playing experience of athletes and may shows better playing techniques in elite athletes [19].

Linear to the hypothesis that higher training routines might improve athlete's body composition, as contended by two prior studies that mesomorphic components was raised and, oppositely, ectomorphic components was reduced after three-months intensive training [27,28]. ENT group as elite athletes had more intensive physical training, thus they had a greater mesomorphic component. Despite having higher intensity of training compared to AJT and ACT group, mesomorph score in AST group was the lowest, which might be caused by other factors including their dietary habit. As is stated by Penggalih *et al* that mesomorphic components is positively associated with energy intake, particularly carbohydrate and fat [15]. Another study also reaffirms the correlation between fat intake with all three somatotype components, followed with carbohydrate intake that determines endomorphy and mesomorphy [29]. Therefore, the lower the consumption, the lower the mesomorphic components as nutrition is an inbuilt part in body composition [30].

Merely ENT group met the adequate energy requirement (97.5%) of all groups, however its protein intake was exceed the needs (139.5%). The other three groups consumed lower amount of carbohydrate and protein than required. Adequate fat intake was shown only by AJT group (97.0%), whereas excessive in ENT and AST group (124.8-130.9%), yet inadequate in ACT group (73.0%).

Variation in dietary intake of the four groups might be influenced by some factors including meal preparation method. ACT is the only group that living autonomously, meanwhile ENT, AST, and AJT groups dwelt in the dormitory and received readily prepared meals every day, the latter condition reinforced them to fulfill their nutrients demand. Nevertheless, choices of menu by catering team were not always suitable for athletes' preference, thus some of whom not finish their meals. Previous study also stated that food preference was one of the factors that determines food intake in athletes [31]. Moreover, only ENT and AJT group which received personal portioned meals according to their individual nutrition recommendation, whereas in AST group athletes took their own meals and ate ad libitum in cafeteria. This factor can be considered as one of the multi-factors affecting inadequate intake of energy, protein, and carbohydrate in AST group, particularly if nutrition education is not presented to the athletes. Of all behaviours that determine nutritional intake, nutrition knowledge is the likely key and modifiable element [32]. Previous study [15] indicated that athletes with the greater nutrition knowledge are more likely to have a greater carbohydrate, fruit, and vegetable intakes [2]. Gaelic footballers were previously found to have an inadequate nutrition knowledge. Poor nutrition knowledge is, therefore, a prevalent issue among athletes and requires corrective action. Another study contends that the male Gaelic Football Athletes had a sub-optimal energy, carbohydrate, vitamin D, and selenium intakes relative to current recommendations and their nutrition knowledge was deemed poor [33].

Study by Iglesias-Gutierreze *et al* suggested that unsuitable menu with athletes' preference and the absence of nutrition education could influence the athletes to fail in meeting their daily nutrition recommendation. It was shown in their study with Spanish junior elite football team (aged 14-16 years old), in which inadequate carbohydrate intake (<55%) was found in all participants. Meanwhile, the lowest dietary intake found in ACT group was suggested to be influenced by the difference of meal preparation method from other groups. Athletes in ACT group were living individually in boarding houses and the meals were prepared by themselves by buying outside or self-cooking. Therefore, individual financial condition and access to healthy food might be the other challenges in meeting their nutrition recommendation.

Fulfilling adequate energy is required to meet the high energy demand in this intermittent high intensity sport. It was suggested that intake of macronutrients brought significant correlation with changes in body weight, height, and somatotype components of athletes [34]. Failure to maintain carbohydrate availability via glycogen or exogenous sources may have ergolytic implications including fatigue, impaired recovery and increased perception of effort [13]. Gravina *et al.* also stated that adequate carbohydrate intake was advantageous in increasing lean body mass and decreasing muscle tissue damage. Therefore, support to sustainable nutrition practices by athletes in accordance with their training loads and body composition goals is required to foster athletes' performance [35].

Besides the adequate intake of carbohydrates, the intake of adequate amounts of protein is also considered crucial to facilitate optimal recovery from and skeletal muscle adaptations to exercise [36]. The recommended total daily protein requirements for football athletes ranges between 1.2 and 1.7 g/kg body mass/ day (Nutrition for football: the FIFA/F-MARC Consensus Conference, 2006) [4]. Along with the total daily protein requirements, it has been suggested that strategic timing and distribution of protein intake leads to maximal skeletal muscle adaptations and recovery [37]. When considering the food intake as seen in the current study, the protein intake may even exceed the current recommendations. Although this does not seem worrisome from a health perspective, it can be speculated that excessive protein intakes are compensated by low or inadequate intakes of carbohydrate. Therefore, the optimal balance between protein and carbohydrate intake should be closely monitored by a nutritionist [38].

The results of the present study confirmed the significant variation of somatotype profile and dietary intake of football athletes in different playing levels, that the highest-level athletes had the most optimum body figures and nutrition status. These findings highlight the importance of well-planned training and diet strategy to support athletes in achieving their physical and on-field performance. Further research should be conducted to investigate the comparison of somatotype profile and nutrition status among different playing positions.

CONCLUSIONS

Among all groups, somatotype profile of elite athletes in ENT group was the closest to ideal somatotype of elite football athletes in high-level of competition. Dietary intake in ENT group was also the most adequate, although the excess intake of fat should be noticed. Athletes in lower level of playing; AST, AJT, and ACT should improve their dietary intake and training to achieve their optimum somatotype goals [4,39].

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Declaration of conflicting interests

The authors declare that they have no conflict of interest that might have affected the performance of this research.

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