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Evaluation of somatotype, dietary intake and blood pressure among female students in Universiti Malaysia Terengganu (UMT), Malaysia

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Abstract

Somatotypes is a description of human anatomy, which provides a quantitative overview of physics as an integral whole. Normally it was presented in a three-number rating, in which each number represents a somatotype variable. The first number represents the component of endomorphy (relative fatness), the second number represents the component of mesomorphy (muscularity) and the last number represents the component of ectomorphy (relative linearity). Multiple investigations have shown the association between somatotype with nutrition and health status. This cross-sectional study on the somatotype component, dietary intake and health status have been conducted among ninety-two female UMT students. Somatotype was calculated using the Carter and Health method. Dietary consumption was assessed using the 24-hour dietary recall technique. While blood pressure was assessed by using standard procedure. Median somatotype score of respondents was (6.39, 4.27, 1.10) indicated that respondents were in mesomorphic endomorph category. By further classifying them into dominant somatotype categories, 74% of respondents were endomorph dominant, 14% mesomorph dominant and 12% ectomorph dominant. BMI of the respondent under normal category was 47.8%, followed by obese (21.7%), overweight (18.5%) and underweight (12%). Moreover, the energy intake of respondents was 1533 kcal/day with the median percentage of total energy contributed by macronutrients was 50.26% derived from carbohydrate, 33.46% from fat and 16.71% from protein. The highest fulfilments of micronutrients were vitamin A (89.44%), but vitamin C (29.74%), calcium (42.56%) and iron (37.95%) did not exceed 50% of RNI. However, sodium intake exceeded RNI by 123.36%. Furthermore, the majority of female students have normal blood pressure with (105.53±9.97/74.65±8.55) mm Hg. The relationship between endomorphy component with systolic blood pressure was ($r = 0.253$, $p = 0.015$) and ectomorphy component with systolic blood pressure was (-0.259, $p = 0.013$). However, there were no relationships between somatotype components and nutrient intake found in this study.

1. Introduction

Somatotype is characterized as the quantification of the human body's present shape and composition (Carter, 2002). It is usually presented in a three-number rating, in which each number represents a somatotype component and always follows the same order. For example, the 3-5 -2 rating is reported in this way and reads as three, five, two. The first number is the endomorphic component (relative fatness), the second number is the mesomorphic component (muscularity) and the last number is the ectomorphic (relative linearity) component (Drywień *et al.,* 2017). These numbers give the magnitude of each component. Each component rating from 1 ½ to 2 ½ is considered low, 3 to 5 is moderate, 5 ½ to 7 is high, and 7 ½ and above are very high (Carter and Heath, 1990).

Individuals can be further categorized into dominant categories of somatotypes which are endomorphic, mesomorphic and ectomorphic, based on the somatotype component score. Somatotype classification will identify physical characteristics that allow all individuals to be differentiated based on tissue development genetics (Drywien *et al.,* 2016). Several factors can affect the somatotype of an individual such as age, sex, genetics, physical activity and nutrition (Raschka and Graczyk,

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2013).

According to Drywień *et al.* (2017) anthropometric parameters of the human body, in most cases, confirm that the uses of BMI are not entirely accurate in assessing a person's physique. BMI calculation for exposure to obesity in healthy adults suggests that BMI cut-off points will confuse healthy adults as being overweight or obese (Hunma *et al.,* 2016). Therefore, BMI cannot differentiate between individual fat mass and muscle. On the other side, skinfold thickness is commonly used to measure fatness and is the best field method since it specifically measures the subcutaneous fat layer (Dulloo *et al.,* 2010)

Energy and nutrient intake are the most important factor in maintaining health and well-being (Yunusa and Ezeanyika, 2013). According to Drywien *et al.* (2016), nutrition intake may affect body somatotype. Previous research by Drywien *et al.* (2017) showed that somatotype had a major effect on the consumption of total protein, animal protein and vitamin E. In addition, the component mesomorphic somatotype is affected by energy intake, fat and carbohydrates (Penggalih, 2017). Also, there is a negative correlation between the endomorphic variable and calories, carbohydrate and protein. The mesomorphic variable negatively correlated with respondents' protein intake and ectomorphic variable positively correlated with calories, carbohydrates, protein and fat intake (Khairil and Wan, 2019).

Malnutrition is a significant health issue in many developed countries. Malnutrition refers to deficits, excess or imbalances in the consumption of nutrients and involves overweight, obesity and diet-related NCDs, such as cardiac disease, stroke, diabetes, and certain cancers (WHO, 2003). It is known that somatotype is related to the fat and muscle content, weight, and height of a person. Physics can therefore be associated with the occurrence of a certain disease. The first study exploring the relationship between somatotype and disease was performed in the 1920s (Drywien *et al.,* 2017). The study from Galić *et al.* (2016) found that endomorphy is the best predictor of metabolic syndrome. Besides, chronic disease frequent among endomorphic dominant subjects (Drywien *et al.,* 2017). On the other hand, the study from Subramaniam *et al.* (2016) said that ectomorphic somatotype is associated with the risk of developing hypertension.

Some previous studies conducted in Malaysia on somatotypes more focused on physical activity and sports performance. Besides, only a few studies about somatotypes and dietary intake has been studied. However, the data are still lacking and need to be further investigated. Thus, this study was conducted to evaluate somatotype, dietary intakes and blood pressure among female university students in Malaysia.

2. Materials and methods

2.1 Research design

A cross-sectional study was conducted among female students in University Malaysia Terengganu between September and November 2019. Respondents were selected based on follows criteria: female students range age between 19 and 25 years with no chronic diseases, not pregnant, not using weight-reducing diets and not professional athletes. The study was approved by the UMT Human Research Ethics Committees (UMT RMIC). No. of human ethics approval is JKEPM/2019/38.

Sample size calculation:

The minimum sample size for the study is calculated using a formula by Daniel (1999):

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where n = estimate sample size, z = the standard value at confident level at 95% = 1.96, p = the estimated prevalence based on the reported prevalence (27.9%) of obesity in Terengganu (Muhammad *et al.,* 2018) and d = margin of error set at 10 %

Thus:

$$n = \frac{(1.96^2) \times 0.279(1-0.279)}{0.10^2}$$

$$n = 77$$

By taking into consideration of 20% drop out rate (the equivalent of 15 respondents), the sample size needed is 92.

2.2 Research instrument

Data collection was conducted by using a self-administrated questionnaire and assessment form in the English language as the research instrument. The questionnaire consists of five sections, section A, section B, section C and section D that used to assess demographic data, anthropometry measurement, blood pressure and dietary intake. Section A consists of six questions, which assess the socio-demographic profile of respondents, such as age, ethnic, hometown, year of study, faculty and marital status.

Section B assess the anthropometry of respondents to determine somatotype. Ten anthropometry measurement which are triceps skinfold, subscapular skinfold,

supraspinale skinfold, calf skinfold, arm girth, calf girth, humerus, femur, height and weight were obtained. Stadiometer, weighing scale and Rosscraft Campbell calipers were used to measure anthropometry data of respondents. All these measurements were then used for determining somatotype by using Carter and Health (1990) equation as follows:

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

Where X = (sum of triceps, subscapular and supraspinal skinfolds) multiplied by 170.18/height in cm.

This is called height-corrected endomorphy and is the preferred method for calculating endomorphy (Heath -Carter, 1990).

2) Mesomorphy = 0.858 × humerus breadth + 0.601 × femur breadth + 0.188 × corrected arm girth + 0.161 × corrected calf girth – height × (0.131) + 4.5
3) Three different equations were used to calculate ectomorphy according to the height-weight ratio (HWR):
   a) If HWR is greater than or equal to 40.75, then ectomorphy = 0.732 HWR – 28.58.
   b) However, if HWR is less than 40.75 but greater than 38.25, then ectomorphy = 0.463 HWR – 17.63
   c) If HWR is equal to or less than 38.25, then ectomorphy = 0.1

While for section C was to evaluate blood pressure of respondents by using Omron digital sphygmomanometer. Assessment form contains two items which were systolic and diastolic blood pressure. For section B and C, the measurement was taken two times and the average ware calculated.

Section D assessed dietary intake of respondents using by 24-hours diet recall method. The form consists of four structured questions in which respondents were asked to recall the time they consume food and beverages, type of food, quantity and method of preparation or brand name of the product.

2.3 Data analysis

The data obtained were analyzed by using the statistical packaged for social science (SPSS) software version 20.0. Firstly, the data was run for normality test to determine the data distribution (Kolmogorov-Simonov test). Then, for normally distributed data, the mean (SD) was used while for non-normally distributed data, the median (IQR) was applied. Furthermore, the descriptive test was used to determine the percentage, frequency, mean, standard deviation, median, and interquartile range. Descriptive test was also used to determine the somatotype components, somatotype categories, Body Mass Index, dietary intake and blood pressure among respondents. Moreover, Spearman correlation was used to determine the relationship between somatotype components with dietary intake and blood pressure. Guildford's Rule of Thumb was used to determine the strength of the relationship between the factors. In all analysis, $p<0.05$ was used to indicate a significant difference.

3. Results

3.1 Socio-demographics

The socio-demographic characteristics of the respondents were shown in Table 1. All of the respondents were female with a median (IQR) age was 22(1.0) years old. Malay respondents contributed the largest proportion (92.4%), followed by Chinese (5.4%), Indian (1.1%) and 1.1% of another race. Majority of students was fourth years students (51.1%), followed by first years (27.2%), second years (12%) and third years (9.8%). Among the respondents, the highest percentage were from the Faculty of Fisheries and Food Sciences (78.3%). Then, followed by Faculty of Business, Economics and Social Development (10.9%), Faculty of Science and Marine Environment (8.7%) and Faculty of

Table 1. Socio-demographic characteristics of female UMT students (n = 92)

Characteristics	Frequency	Percent (%)	Median (IQR)
Age (years old)			
18	0	0.0	22.0 (1.0)
19	7	7.6	
20	15	16.3	
21	15	16.3	
22	38	41.3	
23	14	15.2	
24	2	2.2	
25	1	1.1	
Ethnic			
Malay	85	92.4	
Chinese	5	5.4	
Indian	1	1.1	
Others	1	1.1	
Year of study			
First year	25	27.2	
Second year	11	12.0	
Third year	9	9.8	
Fourth year	47	51.1	
Faculty			
FPSM	72	78.3	
FSSM	8	8.7	
FTKKI	2	2.2	
FPEPS	10	10.9	
Marital status			
Single	100	100	
Married	0	0.0	

Ocean Engineering Technology and Informatics with (2.2%). All of the respondents (100%) were single.

3.2 Somatotype of respondents

Median somatotype score of all respondents for endomorphy, mesomorphy and ectomorphy was (6.39, 4.27, 1.10) (Table 2). This result indicated that female students belonged to mesomorphic endomorph body somatotype.

Table 2. Median (IQR) of somatotype components score among respondents

Somatotype components	Median (IQR) n = 92
Endomorphy	6.39 (1.55)
Mesomorphy	4.27 (3.03)
Ectomorphy	1.10 (2.30)

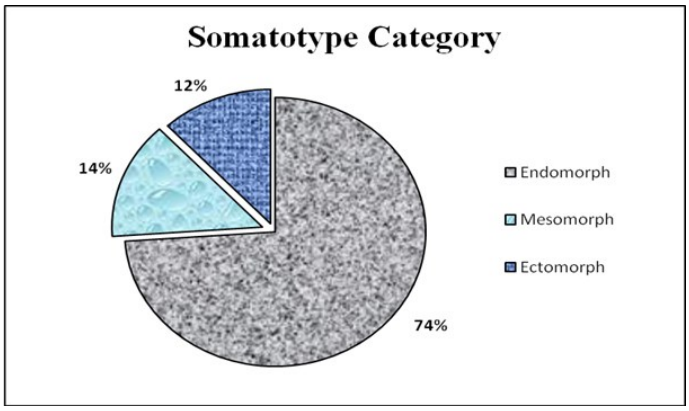

Figure 1. Dominant somatotype category of respondents

Based on somatotype components score, respondents were further classified into three dominant somatotype categories (Figure 1). Majority of female students belonged to the dominant endomorph category (74%), followed by mesomorph dominant (14%) and 12% of respondents were ectomorph dominant.

3.3 Body mass index

The median BMI among respondents was 23.40 (8.94) kg/m^2. From Table 3, it can be observed that most of students' Body Mass Index were within the normal category (47.8%), followed by obese (21.7%), overweight (18.5%) and underweight (12%).

Table 3. Body mass index among respondents

BMI categories	Frequency	Percent (%)	Median (IQR) n = 92
BMI (kg/m^2)			23.40 (8.94)
Underweight	11	12.0	
Normal	44	47.8	
Overweight	17	18.5	
Obese	20	21.7	
Total	92	100	

3.4 Dominant somatotype category versus BMI category of respondents

Table 4 shows the somatotype category versus Body Mass Index among Respondents. The results show that sixty-eight respondents were endomorph dominant. Based on BMI categories classification, forty-four of them were in normal BMI, fourteen were overweight,

Table 4. Somatotype category versus BMI category among respondents (n = 92)

Somatotype categories	BMI categories				Total
	Underweight	Normal	Overweight	Obese	
Endomorph	0	44	14	10	68
Mesomorph	0	0	3	10	13
Ectomorph	11	0	0	0	11
Total	11	44	17	20	92

Table 5. Dietary intake of respondents, n = 92

Dietary Intake	Median (IQR)	RNI	% fulfilment RNI
Energy (kcal/day)	1533.04 (621.50)	1840	83.32
Carbohydrate (g/day)	192.64 (252.59)	50-65% TEI	50.26
Protein (g/day)	64.05 (34.67)	10-20 % TEI	16.71
Fat (g/day)	56.99 (34.99)	25-30%TEI	33.71
Vitamin A (µg/day)	536.62 (729.65)	600	89.44
Vitamin C (mg/day)	20.82 (38.21)	70	29.74
Calcium (mg/day)	425.62 (320.62)	1000	42.56
Iron (mg/day)	11.01 (8.49)	29	37.95
Sodium (mg/day)	1835.36 (1218.66)	1500	122.36

and ten were obese. Besides, there were thirteen respondents were mesomorph. According to BMI categories classification, 3 of them were overweight and 10 were obese. While eleven respondents were ectomorph and all of them were in the underweight BMI category.

3.5 Dietary intake of respondents

Based on the results from Table 5, the median energy intake of respondents was 1533 kcal/day. The median percentage of total energy contributed by macronutrients was 50.26% derived from carbohydrate, 33.46% from fat and 16.71% from protein. Besides, the highest fulfilments of micronutrients were vitamin A with 89.44%. While, vitamin C intake, their calcium and iron did not exceed 50% of Recommended Nutrient Intake with 29.74%, 42.56% and 37.95% respectively.

3.6 Blood pressure of respondents

Table 6 shows that the mean blood pressure of the respondent was in the normal range, where systolic blood pressure was (105.53±9.97) mm Hg and diastolic blood pressure were (74.65±8.55) mm Hg.

Figure 2 shows the percentage of respondents with hypertension based on their blood pressure level. The results indicated that 4% of female students have hypertension and 23% with pre-hypertension.

3.7 Relationship between somatotype components and dietary intake

From the results obtained in Table 7, there was no significant relationship between all somatotype components with energy, protein, carbohydrate, fat, vitamin A, vitamin C, calcium, iron, and sodium.

Table 6. Mean±standard deviation blood pressure of respondents

Blood pressure	(Mean±SD) n = 92
Systolic	105.53±9.97
Diastolic	74.65±8.55

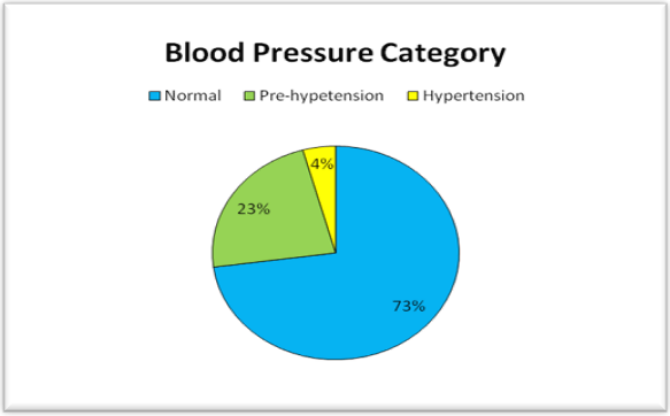

Figure 2. Blood pressure of respondents

3.8 Relationship between somatotype components and blood pressure

The finding in Table 8 indicated that there was a significant positive correlation between endomorphy components and systolic blood pressure (r = 0.253, p = 0.015). This result showed that respondents with higher endomorphy components have higher systolic blood pressure and vice versa. Besides, there were negative correlation between ectomorphy components and systolic blood pressure (r = -0.259, p = 0.013). Thus, this result indicated that lower ectomorphy components, higher systolic blood pressure and vice versa.

Table 7. Relationship between somatotype components and dietary intake (n = 92)

Dietary intake	Median (IQR)	Endomorphy		Mesomorphy		Ectomorphy	
		r	p	r	p	r	p
Energy (kcal/day)	1533.04 (621.50)	0.058	0.586	0.133	0.205	-0.083	0.434
Protein (g/day)	64.05 (34.67)	0.048	0.650	0.043	0.686	-0.092	0.384
Carbohydrate (g/day)	192.64	0.000	0.997	0.880	0.406	-0.024	0.818
Fat (g/day)	56.99 (34.99)	0.088	0.403	0.164	0.118	-0.107	0.310
Vitamin A (µg/day)	536.62	0.123	0.243	0.025	0.811	0.005	0.960
Vitamin C (mg/day)	20.82 (38.21)	0.108	0.403	0.164	0.118	-0.107	0.310
Calcium (mg/day)	425.62	-0.010	0.925	-0.020	0.850	0.005	0.960
Iron (mg/day)	11.01 (8.49)	0.037	0.724	0.099	0.348	-0.060	0.568
Sodium (mg/day)	1835.36 (1218.66)	0.108	0.305	0.147	0.161	-0.124	0.240

*Spearman correlation is significant at p<0.05 level. Spearman correlation indicates that there is no relationship between somatotype components with dietary intake.

Table 8. Relationship between somatotype components with blood pressure, n = 92

Health Status	Mean±SD/ Median (IQR)	Endomorphy		Mesomorphy		Ectomorphy	
		r	p	r	p	r	p
Blood Pressure							
Systolic (mm Hg)	105.53±9.97	0.253*	0.015	0.343	0.001	-0.259*	0.013
Diastolic (mm Hg)	74.65±8.55	0.301	0.004	0.307	0.003	-0.28	0.007

* Spearman correlation is significant at p< 0.05 level

4. Discussion

In the present study, the somatotype components score of respondents was consistent with data obtained in research by Pastuszak *et al.* (2016) among female students from the Warsaw University of Technology. The result indicates that the mean components of the students' somatotype were (5.1, 3.6, 2.8) and displayed a significantly greater endomorphic participation. In addition, this finding was also supported by the previous study of Khairil and Wan (2019) among Kuala Terengganu government staff. Researchers found females had a higher endomorphic component, a slightly higher mesomorphic component and a lower ectomorphic component (8.77, 4.99, 0.77). This result may be explained by the fact that female has high skinfold thickness (Kaur and Malik, 2016).

Besides, the present study in accordance with the study by Wan Abdul Manan *et al.* (2015) among three institutions of higher learning in the state of Kelantan which also classified the majority of female students under endomorph category (34.5%), followed by mesomorphy (3.9%) and ectomorphy (12.2%). However, a study by Liiv *et al.* (2013) finding said that the ectomorph was the prevailing somatotype among the female dancers. It contradicts with this study finding which endomorph was prevailing somatotype. The possible reason for different results because the previous study conducted on physically active respondents, while most of the female students in this study are non-athletes and they have weak efficiency for participating in physical activity (Khasawneh, 2015).

The BMI obtained in the present study was in line with the previous study by Kamaria *et al.* (2016) on his research among 242 undergraduate students in UiTM Puncak Alam Campus, Selangor in which the researcher also found that most of the female students were in the normal BMI category (58.7%). Besides, the research from Hakim *et al.* (2012) among 200 students from four Malaysian universities in Selangor also found that 60.9% of female students were within the normal BMI category. The reason might because the female UMT students were having proper nutrition intake. Another reason might be due to improved growth of socio-economic and better health services provided to the people in Malaysia (Moy *et al.,* 2008).

In addition, there was a high prevalence of overweight and obese among female students in the present study (21.7%) and (18.5%) respectively. This finding was in accordance with the previous study conducted by Kuan *et al.* (2011) among 600 students at Malaysia Sarawak University in which 22.0% of female students were overweight and obese. The likely explanation for the high prevalence of overweight and obese among female students was due to unhealthy eating habits such as regular high-fat snacking and high-calorie diet (Kremmyda *et al.,* 2008; Yahia *et al.,* 2008).

Moreover, the results showed that 12% of female students were underweight. This study in line with the previous study conducted by Wan Abdul Manan *et al.* (2015) among 180 students aged between 19 to 25 years old from three institutions of higher learning in the state of Kelantan in which the prevalence of underweight was 15.0%. Besides, a study by Huda and Ahmad, (2010) also showed a high prevalence of underweight (33%) among female students in USM. The high prevalence of underweight among female university students may be due to their desire for thinner body size (Sakamaki *et al.,* 2005). Another reason may be that their energy consumption does not meet the recommended intake suggested by RNI. Therefore, in general, most female students in UMT were having normal weight as there were better nutrition intake and health services provided. However, the prevalence of overweight and obese was high and the need for weight control.

In this study, the results show that 13 of the mesomorphic respondents (14.1%) were categorized into overweight and obese categories of BMI using BMI cut-off points. This finding was similar to that conducted among government employees in Kuala Terengganu by Khairil and Wan, (2019). This study also shows that 30.4% of mesomorphic respondents were classified as overweight and obese by using BMI cut-off points. In addition, findings from the study by Wan Abdul Manan *et al.* (2015) also indicate a similar trend in which 24.2% of mesomorphic respondents were classified as overweight and obese by using BMI cut-off points. According to Bolunchuk *et al.* (2000), individuals who are categorized as mesomorphic have a higher fat-free mass compared to endomorphic and ectomorphic. Since BMI cannot distinguish between fat mass and muscle mass in individuals, dominant mesomorphic individuals

are therefore heavier. The use of BMI may therefore misclassify them as overweight and obese (Dulloo, 2010).

As compared to the previous study by Rajikan *et al.* (2019) where the mean energy intake (1126.70±332.12) kcal/day was lower from the present study. The previous study shows a lower mean energy and carbohydrate intake but higher fat intake among undergraduate respondents. It seems possible that these results are due to students may even skip meals or simply eat some biscuits. Besides, low-calorie intake among students also may due to having limited food choices (Yap *et al.,* 2019). A study by Shimbo *et al.* (2004) reported that Japanese female university students had an adequate intake of vitamin A. These results are in accord with a recent study indicating that high fulfilment of recommended nutrient intake for vitamin A. In addition, Zainuddin (2015) report that the median intake of vitamin A was about 480/day or 88% of the recommended intake for vitamin A. High intake food that fortified with vitamin A such as breakfast cereal, cornflakes, and milk powder might be the reason for adequate intake of vitamin A among female students.

Moreover, this study found that the RNI level for calcium intake was not met by the respondents. This finding is consistent with the national findings of the Malaysian Adult Nutrition Survey (MANS) in Malaysia, which found calcium intake to be the lowest in the 18-39 age group (Mirnalini *et al.,* 2008). Project EAT (Eating Among Teens) reported a decrease in daily intakes of calcium, total servings of dairy products and servings of milk during the transition from adolescence to young adulthood in the United States (Larson *et al.,* 2009). These results reflect those of Singh *et al.* (2015), who found calcium intake to be highly positively correlated with milk intake.

The results of this study also indicate that there was an insufficient intake of iron in female university students. These results were supported by Hakim *et al.* (2012), where many female students (90.55%) did not meet the iron RNI. Inadequate intake of iron which may lead to iron deficiency anaemia (Gan *et al.,* 2011). The explanation for iron intake deficiencies can be due to lower consumption of animal products such as meat products and meat products.

Comparison of other intakes of micronutrient, sodium intake of the respondent was exceeding the RNI with 122.36%. The median sodium intake was high among university students in this study (1835.36 (1218.66)) mg/day and was consistent with Gan *et al.* (2011) and Mirnalini *et al.* (2008). The previous study shows that sodium intake of university students 2322.5±958.0 mg/day and 2734±70.1 mg/day respectively. The possible reason for high sodium intake was the frequent intake of instant noodle, fast food, and excessive intake of soy-based sauces, which are reported to be high in sodium. According to WHO, sodium intake has consistently been associated with blood pressure, a major risk factor for coronary heart disease and stroke. Thus, dietary intake of sodium should be limited from all sources to reduce the risk of coronary heart disease and stroke (Choong *et al.,* 2012). Thus, in order to fulfil all nutritional requirements, all students need to make several changes to their usual daily food intakes such as increasing fruits and vegetable intake (Rajikan *et al.,* 2019). Furthermore, the nutrition education program and interventions among university students should highlight the importance of eating three main meals, iron and calcium-rich foods, and sodium intake reduction (Gan *et al.,* 2011). Overall, to maintain good health and quality of life, balance and adequate nutrition are important (Memis and Sanlier, 2010).

The blood pressure in the present study was compromised with finding from Ghazi *et al.* (2017) among 410 University students in Shah Alam, Malaysia. The results show that systolic blood pressure (116.59±14.28 mm Hg) and diastolic blood pressure (72.40±10.03 mm Hg) were in the normal range. Additionally, this study also supported by a study by Alhawari *et al.* (2018) among University students in Jordan in which the mean systolic was 116.71 mm Hg and diastolic was 78.81 mm Hg. Early detection of high blood pressure is usually difficult in adolescents, mostly due to underestimation for the long-term effect of high blood pressure and BMI and the relatively minor effect of diseases on the well-being of adolescents compared to adults (Mathew *et al.,* 2012).

Moreover, the present study was in agreement with the earlier study, where results from earlier study show that the prevalence of hypertension of female was 6.4% (Ghazi *et al.,* 2017). Besides, a study by Omar *et al.* (2016) found that the prevalence of young adults (individuals with age less than 40 years old) hypertension in Malaysia was 17.3%. The previous study was slightly higher compared with the present study. The reason for the high prevalence of hypertension from the previous study compared with a recent study might be due to the variation genetic or socio-environment factors (Rampal *et al.,* 2008). Besides, high sodium consumption (1835.36 mg/day) in this study also may contribute to the high prevalence of hypertension among female students. WHO (2003) stated that sodium intake has been related to blood pressure which is a major risk factor for coronary heart disease and stroke.

The results obtained for relationship between somatotype components with dietary intake in contrast with the previous study conducted among 308 government employees in Kuala Terengganu where there were an association between endomorphy components with calories, carbohydrate, and protein intake. Mesomorphy components correlated negatively with protein intake and ectomorphy correlated positively with calories, carbohydrate, protein, and fat intake. Moreover, a study by Raschka and Aichele (2014) for female physical education students aged between 20 to 46 years old report that, endomorphy were inversely related to carbohydrate and protein intake, mesomorphy were inversely related to energy, carbohydrate and fat intake, while ectomorphy were positive relationship with energy, protein and fat intake. Although the previous study has a relationship, the strength of the correlation coefficient was weak (Raschka and Aichele, 2014; Khairil and Wan, 2019).

The current study shows no relationship between somatotype components and dietary intake may because somatotype are more related to sports performance and physical activity. A study from Ryan-Stewart *et al.* (2018) has demonstrated a link between somatotype and an aspect of anaerobic performance, Drywen *et al.* (2017) conclude that somatotype significantly related to physical activity and Tóth *et al.* (2014) about variations somatotype in sport. In addition, somatotype varied with sex and age (Widiyani *et al.,* 2011). Besides, it also could be due to the fact that this study was done on a limited number of respondents compared to the previous study.

A study by Herrera *et al.* (2004) on associations between somatotype and blood pressure during ageing in an institutionalized Venezuelan elderly population reported high blood pressure levels in individuals with high endomorphy and mesomorphy levels. While the inverse relationship between ectomorphy with blood pressures. However, Makgae *et al.* (2007) study among rural children in South Africa shows a significant relationship between diastolic blood pressure and ectomorphy. In females, changes in blood pressure seem to be associated with internal hormonal and physiological changes related to reproduction and ageing, rather than with external factors (Herrera *et al.,* 2004).

5. Conclusion

In conclusion, most of the respondents belonged to mesomorphic endomorph body somatotype. While the endomorph dominant somatotype category was seen among female UMT students. Besides, the Body Mass Index (BMI) among female students was in the normal BMI category. In addition, by using BMI cut-off points, 14.1% of mesomorph respondents were misclassified into overweight and obese BMI categories. Moreover, the energy intake of respondents was 1533 kcal/day with the median percentage of total energy contributed by macronutrients was 50.26% derived from carbohydrate, 33.46% from fat and 16.71% from protein. The highest fulfilments of micronutrients were vitamin A, but vitamin C, calcium and iron did not exceed 50% of RNI. However, the sodium intake of respondents exceeds RNI by 123.36%. Furthermore, the majority of female students have normal blood pressure. Moreover, there is no relationship between somatotype components and nutrient intake among female UMT student. In addition, there is a positive relationship between endomorphy and systolic blood pressure while the negative relationship between ectomorphy and systolic blood pressure.

Conflict of interest

The authors declare no conflict of interest.

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