

Characteristic of Somatotype, Obesity and Nutrition Intake in Adult Woman (Study in 5 Different Civil Servant Offices in Semarang City)

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Submission date: 16-Jul-2020 08:08PM (UTC+0700)

Submission ID: 1358206764

File name: Study_in_5_Different_Civil_Servant_Offices_in_Semarang_City.pdf (2.38M)

Word count: 4135

Character count: 21985

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Abstract—Somatotype is parameter used to describe body composition. Nutrition intake affects somatotype. The aim of this study is to analyze the correlation of somatotype with obesity parameter and to analyze the correlation of nutrition intake with somatotype. This study was an observational with cross sectional design. The study subject was 64 women aged 25-40 years in Semarang, chosen by using random sampling method. The studied variable were somatotype, waist circumference, BMI (Body Mass Index) and nutrition intake. Nutritional intake was measured using Semi Quantitative Food Frequency Questionnaire (SQ-FFQ). The data was analyzed by using Pearson Product Moment and Rank Spearman. Most subjects had a body type of endomorphic (75%) with highest sub category was mesomorphic-endomorph (59.4%). Subjects who had nutritional status of overweight were 50% and 51,6% had central obesity. The value of endomorph, mesomorph and ectomorph was related to BMI and waist circumference. There was positive correlation between energy intake and endomorph value. In contrast, there was negative correlation between energy intake and ectomorph value. The higher endomorph and mesomorph value and the lower ectomorph value, the higher waist circumference and BMI. The higher energy intake, the higher endomorph and the lower ectomorph value.

Keywords—somatotype, obesity, nutrition intake

I. INTRODUCTION

Adulthood is the longest period in human life, started from 20 to 65 years. One of distinctive characteristic of adult is financially independent. Financial independence is indicated by having job or income [1]. This economic power can be the support of the food intake of workers [2]. Workers has relatively high carbohydrate and fat especially saturated fat in their diet [3]. Besides, based on a study, most of office worker

do not do exercise in 1 last week, meanwhile physical activity in working activity is categorized as moderate [2]. Poor eating pattern and low physical activity increase obesity in adulthood [4].

The study about eating habits that conducted on staff of health department at south Sulawesi shows that 62% respondent has poor eating habits, high in carbohydrate and fat and low in fiber so that can be one factor causing obesity [5]. Another study about eating habits on office worker shows that office worker has poor eating habits, high calorie and low fiber as 72% [6]. Good diet is an eating habits that applies balanced nutrition in term of quality and quantity. Balanced nutrition shows whether the food consumed is in accordance with the recommendation so that it can fulfill individual needs to achieve optimal health. In general, balanced nutrition recommended for adult is high fiber intake, adequate macronutrient, low cholesterol, saturated fat and sodium [7]. Good eating habits can be a protective factor toward obesity, metabolic syndrome and cardiovascular hypertension [8,9].

Obesity, particularly obesity central or abdominal obesity is a one factor of cardiovascular risk and metabolic disorder [10]. Waist circumference is an indicator for insulin resistance and metabolic syndrome, particularly for non obese individual [11]. Women has higher adipose fat which also increase the risk of heart disease. Fat distribution is related to body shape of an individual, in which the women has tendency to have pear shape body [12].

Classification of body type can be referred to somatotype. Somatotype is a quantitative tool which can describe body shape type of a human. There are 13 types'

categories of somatotype body shape, however those categories can be simplified into four categories, those are central, endomorph, mesomorph and ectomorph [13]. Central type is a body type in which no component differs by more than one unit from other two. Endomorph is indicated by round shape body, big and round head, short bone, short neck, narrow shoulder, wide leg and waist. Mesomorphic type is indicated by strong and tough muscle, big bones, has narrow waist, and wide shoulder. Ectomorphic type is indicated by slim body, small body, small bones, narrow shoulder and indefinite muscles [14].

Individual who is dominant in endomorphic has tendency to have abdominal obese [15]. According to several studies endomorphic type has higher prevalence on women compare to man, meanwhile man has higher in ectomorphic compare to women [16]. Compare to adult in Japan, adult in Indonesia has lower body height and knee height both for man and women [17]. Several studies only identify body type on several individual characteristic. Based on study conducted in Yogyakarta, endomorphic has higher score for women compare to man. Man tend to have lower endomorphic but its ectomorphic is higher than women. The Mean somatotype of that study is meso-endomorphic in woman dan central in man [18]. However there is no studies about body type that can be one of the parameter of obesity and its relationship with nutrition intake. Therefore, The aim of this study is to analyze the correlation of somatotype with obesity parameter and to analyze the correlation of nutrition intake with somatotype component on adult women.

II. METHOD

This was an observational study with cross sectional design in 5 office in Semarang City which is Balai Besar Teknologi Pencegahan Pencemaran Industri (BBTPPI), Dinas Pekerjaan Umum (DPU), Dinas Perindustrian dan Perdagangan (Disperindag), Dinas Tenaga Kerja dan Perhutani Kota Semarang. The study was conducted in July-September 2018. This study also has ethic code by ethic commission of Health Research Faculty of Medicine Diponegoro University - Dr. Kariadi Hospital Semarang with the number no 469/EC/FK-RSDK/VII/2018.

The samples in this study were 64 subjects counted based on the estimation proportion in one population. Inclusion criteria on study subject were women 15-40 years old, were not in a certain diet, do not pregnant, and want to be involved in study by filling Informed Consent form. Subject was taken using consecutive sampling. Independent variable is eating habit consist of energy, protein, fat, carbohydrate, fiber, saturated and unsaturated fat intake. Dependent variable is somatotype component.

Intake of energy, protein, fat, carbohydrate, fiber, saturated and unsaturated fat is the average of intake of energy, protein, fat, carbohydrate, fiber, saturated and unsaturated fat in a day from food, beverage and supplement

obtained from interview of food intake for last one month by using Semi Quantitative Food Frequency (SQ FFQ). Food intake data was analyzed by using software nutrisurvey. The level of adequacy of energy, protein, fat, carbohydrate, fiber, and sodium was obtained by comparing energy need individually. Waist circumference is the length of the cycle or someone body at the part of tummy in line with navel. The measurement of waist circumference is measured from middle between lowest interior costa and crista iliaca using metline. Waist circumference measurement was conducted for twice by trained individual. Waist circumference is categorized as normal if it is ≤ 80 cm and obese if it is > 80 cm.

Somatotype is quantitative tools which can describe the type of body shape of an individual. It consist of 3 components those are endomorph, mesomorph and ectomorph. Endomorph is calculated by the formula = $-0.7182 + 0.1415(X) - 0.00068(X^2) + 0.0000014(X^3)$ with $X = (\text{triceps fat thickness} + \text{subscapular fat thickness} + \text{suprailiac fat thickness}) \times (170.18/\text{TB})$. Mesomorph is calculated using the formula = $[(0.858 \times \text{humerus wide}) + (0.601 \times \text{femur wide}) + (0.188 \times \text{corrected upper arm circle line}) + 0.161 \times \text{corrected leg circle line}] - (\text{body height} \times 0.131) + 4.50$. Corrected upper arm circle line = upper arm circle line - triceps fat thickness / 10 and corrected leg circle line = leg circle line - leg fat thickness / 10. Ectomorph is calculated by formula if $\text{HWR} \geq 40.75$, ectomorph = $\text{HWR} \times 0.732 - 28.58$, if $40.75 > \text{HWR} > 38.25$, ectomorph = $\text{HWR} \times 0.463 - 17.63$, if $\text{HWR} \leq 38.25$, ectomorph = 0.1. HWR is $\text{height} / \text{cube roof of weight}$ [13].

Somatotype is categorized into 13 categories which are 1) Centered type if there is no different component more than one unit from other two types 2) Balanced endomorph if endomorphy is dominant meanwhile mesomorphy and actomorphy are equal 3) mesomorphic endomorph if endomorphy is dominant meanwhile mesomorphy is more than ectomorphy 4) mesomorph-endomorph if mesomorphy and endomorphy is the same and ectomorphy is smaller 5) endomorphic mesomorph if mesomorph is dominant, meanwhile endomorphy is higher than ectomorph 6) balance mesomorph if mesomorphy is dominant, endomorphy and ectomorphy is the same. 7) ectomorphic mesomorph if mesomorph is dominant, ectomorphy is higher than endomorphy 8) mesomorph mesomorph if the mesomorphy and ectomorphy is the same and endomorphy is smaller 9) mesomorphic ectomorph if ectomorphy is dominant meanwhile mesomorphy is more than endomorphy 10) balance ectomorph if ectomorphy is dominant, endomorphy and mesomorphy is the same 11) endomorphic ectomorph if ectomorph is dominant, endomorphy is more than mesomorphy 12) endomorph-ectomorph if endomorphy and ectomorphy is the same and mesomorphy is less 13) ectomorphic endomorph if endomorphy is dominant, ectomorphy is higher than mesomorphy. From those 13 category can be categories it can be categorized into 14 categories (somatotype II) which is 1) Central if there is no component which differentiate more than one unit from other

two 2) endomorph if endomorph is dominant mesomorph and ectomorph is more than a half lower unit.3) mesomorph if mesomorph is dominant endomorph and ectomorph is more than one and a half less and 4) ectomorph if ectomorph is dominant, endomorph and mesomorph is more than one and a half less [13].

Analysis data was conducted by using SPSS program. Analysis univariate is conducted by presenting data from distribution table from variable studied. Pearson correlation is used to analyze the correlation between variables normally distributed and Rank analysis Rank Spearman is used to analyze the correlation between variables not normally distributed.

III. RESULT

The average age of study subject was 31 years old and have average BMI of 22,31 kg/m² and waist line of 79,28 cm. average score for endomorph was 5,22 ± 0,86, meanwhile average score for mesomorph and ectomorph were 3,88 ± 1,08 and 1,61 ± 0,91 respectively. All category the adequacy of food intake was above 70% except for usaturated fat intake (49,03%) and fiber (50,58%) only fulfill a half of its requirement. In contrast, average saturated fat intake is categorized as excess which 152,04 ± 44,2 % of the need. Meanwhile carbohydrate and energy intake is categorized as adequate 91,15 ± 19,47 % and 86,29 ± 16,92 %.

A half of adult women aged 25-40 years old has nutritional status of overweight (23-24,9 kg/m²) and 51,6% had central obesity from indicator of wais line. We divide somatotype into two those are somatotype I and somatotype II. somatotype I has 13 category, meanwhile somatotype II is the simplification of somatotype I into 4 categories , those are central, endomorph, mesomorph, and ectomorph. For 75% subject had body type of dominant endomorph with most frequent sub category of mesomorphic-endomorph (59,4%). Subject with category dominant mesomorph, ectomorph, central, were 6,3%, 1,6% dan 1,6% respectively.meanwhile 15,5 % the rest cannot be included into 4 category of somatotype I because they were classified into mesomorph endomorph (14%) and endomorph ectomorph (1,5%).

Table 1. Characteristic Of Study Subject

Variable	Mean ± SD	Minimum	Maximum
Age (year)	31.12±4.83	25	40
Mass Body Index (kg/m ²)	22.31±1.9	18.00	24.90
Waist Circumference (cm)	79.28±5.14	68.0	90.5
Somatotype score			
Endomorph	5.22 ± 0.86	2.4	7.1
Mesomorph	3.88 ± 1.08	2	7.2
Ectomorph	1.61 ± 0.91	4	4.1
Food intake			
Energy adequacy intake (%)	91.15±19.47	49.03	130.75

Carbohydrate adequacy intake (%)	86.29±16.92	47.06	117.58
Protein adequacy intake (%)	73.39±22.67	39.66	157.26
Fat adequacy intake (%)	90.05±17.67	40.46	124.71
Fiber adequacy intake (%)	50.58±28.80	16.56	198.50
Saturated Fat adequacy intake (%)	152.04±44.20	62.09	250.58
Non Saturated adequacy intake (%)	49.03±17.59	21.76	100.53

Table 2. Frequency distribution of nutritional status and Somatotype of Study Subject

Variable	Category	n (%)
Nutritional status	Normal (18,5-22,9 kg/m ²)	32 (50)
	Overweight (23,0-24,9 kg/m ²)	32 (50)
Waist circumference	Normal (< 80 cm)	31 (48.4)
	Central obesity (> 80 cm)	33 (51.6)
Somatotype I	Central	1 (1.6)
	Balanced endomorph	8 (12.5)
	Mesomorphic endomorph	38 (59.4)
	Mesomorph endomorph	9 (14.1)
	Endomorphic Mesomorph	4 (6.3)
	Ectomorphic endomorph	2 (3.1)
	Endomorph ectomorph	1 (1.6)
	Endomorphic ectomorph	1 (1.6)
	Balanced ectomorph	0 (0)
	Mesomorphic ectomorph	0 (0)
	Mesomorph ectomorph	0 (0)
	Ectomorphic Mesomorph	0 (0)
	balanced Mesomorph	0 (0)
Somatotype II	Central	1 (1.6)
	Endomorph (endomorph dominant)	48 (75)
	Mesomorph (mesomorph dominant)	4 (6.3)
	Ectomorph (ectomorph dominant)	1 (1.6)
	Others	10 (15.5)

Correlation test show endomorph score, mesomorph and ectomorph correlate significantly with obesity parameter which are waist line and BMI (p<0,05) (tabel 3). Among all variables of intake adequacy level, only energy adequacy level which has significant correlation with other somatotype component (p<0,05) (tabel 4). There is positive correlation between energy intake level and endomorph score. In contrast, their was a negative correlation between energy intake level and ectomorph score (table 4).

Table 3. the correlation of somatotype component and obesity parameter

Variable	Waist line		BMI	
	r	p	r	p
Endomorph	0.420	0.001^a	0.567	0.001^b
Mesomorph	0.263	0.036^b	0.504	0.001^b
Ektomorph	-0.545	0.001^b	-0.819	0.001^b

^aCorrelation pearson ; ^bCorrelation Rank Spearman

Table 4. correlation of food intake and somatotype omponent

Variable	Endomorph		Mesomorph		Ectomorph	
	r	p	r	p	r	p
Energy adequacy level	0.304	0.014^a	0.161	0.204 ^b	-0.296	0.017^b
Carbohydrate adequacy level	0.215	0.088 ^b	0.041	0.746 ^b	-0.150	0.237 ^b
Protein adequacy level	-0.044	0.729 ^b	-0.046	0.718 ^b	0.018	0.890 ^b

Fat adequacy level	0.033	0.789 ^b	0.211	0.095 ^b	-0.226	0.073 ^b
Fiber adequacy level	-0.195	0.123 ^b	0.087	0.494 ^b	-0.005	0.970 ^b
Saturated fat adequacy level	-0.017	0.892 ^b	0.056	0.662 ^b	-0.020	0.874 ^b
Non saturated fat adequacy level	0.139	0.275 ^b	-0.057	0.655 ^b	0.073	0.569 ^b

^aCorrelation pearson ; ^bCorrelation Rank Spearman

IV. DISCUSSION

Somatotype is defined as qualification of body shape and body composition of human. Somatotyping method is used to assess body shape and body composition. Three somatotype usually used are endomorph, mesomorph and ectomorph which is differentiated based on body size and body composition [13]. In general, the body categorized as endomorph has most dominant body component of fat, meanwhile on mesomorph the most dominant is muscle and in ectomorph the most dominant is bones.

Someone sometimes do not included into those three categories but the combination of two categories. Carter and Heath divide somatotype into 13 category based on 2 dimensional area, those are central, balanced endomorph, Mesomorphic endomorph, Mesomorph-endomorph, endomorphic Mesomorph, balanced Mesomorph, ectomorphic Mesomorph, Mesomorph-ectomorph, Mesomorphic ectomorph, balanced ectomorph, endomorphic ectomorph, endomorph-ectomorph, ectomorphic endomorph in which inthis study we named is as somatotype I. Furthermore, these 13 category is classified into four categories those are central, endomorph, mesomorph and ectomorph which we name it assomatotype II.

The result of this study shows that 75% subject has boby type of endomorph dominant (somatotype I) with the highest population was -endomorph (59,4%), followed by *Mesomorph endomorph* (14.1%) and *balanced endomorph* (12.5%). It means that 75% women has highest component of fat in their body. However if it compare to obesity parameter which is waist line an BMI, subject with overweight and central obesity only 50% and 51,6%. Somatotype is more sensitive to determine the excess tissue adipose compare to waist line and BMI. BMI is widely used only for determining overwirgh and obesity, but it is not a universal formula to classify someone into certain body type and determine the excess of diposa tissue [19]. Besides, there were ten dimension of antropometry used ro calculate somatotype such as height, body weight, four skin fold (triceps, subskapula, supraspinale, calf medial, and two circle of extremity (folded arm, calf) in which those dimension indicates adipose storage spot [13].

The author found that somatotype is significantly related to obesity parameter which is waist line and BMI ($p < 0,05$) (table 3). This result is in line with the study result of Drywien et al (2017) which show that there is a significant

correlation between somatotype and waist line. Hip line, waist line to hip line ratio, and BMI on women aged 57-88 years old [20]. Besides, it was mentioned that by somatotype endomorph and mesomorph has positive correlation with waist line and BMI. In contrast ectomorph women have negative correlation with waist line and BMI. It means that, the higher endomorph and mesomorph and the lower ectomorph the higher the waist line and BMI. His result is in line with the study of Buffa et al (2007) which stated that waist line and BMI is related to endomorph man and woman.

Considered form its average, in this study endomorph women has ag=]verage waist line of 79.24 cm which is not significantly different to ectomorph 78.5 cm. however, the average BMI of endomorph women in this research is much higher (22.29 kg/m²) compare to BMI of ectomorph women which was 19.02 kg/m². This phenomenon confirm the our finding that endomorph women who has fat storage on adipose tissue is more than ectomorph and also has higher BMI compare to ectomorph woman.

Considered from physical appearance, endomorphic body type is indicated by the round body shape, has more fat cell under the skin, has more lipid cell under the skin or visceral fat, wais line is more that chest line, big head, wide face and short neck. Besides, endomorph has round shape, body part and finger relatively short and weak, leg and hand small and strong bone. They also have muscle tissue which is not really develop to accumulate fat [19,20]. Meanwhile mesomorph is type of muscle body shape with strong skeleton, wide shoulder and chest, strong body part, massive hip and fast muscle development. In contrast, endomorph, this type of body is identified by slim body, weak muscle and bone; arm not straight, short body and long body part. Narrow chest and flat, round arm, weak tight and shoulder, long finger and smooth and lean [21].

Only energy adequacy intake has significant correlation with somatotype ($p < 0.05$) (table 4). There was positive relationship between energy intake and endomorph score. In contrast there was negative correlation between energy intake and ectomorph (table 4). It means, the higher the energy intake the higher endomorph core and the higher endomorph score and the lower ectomorph score. Based on recall intake data (not presented data), the average intake adequacy level of endomorph women is higher (89.68%) compare to ectomorph women (75.65%). This result is opposite with drywien et al (20160 study which stated that women aged 21-25 years with somatotype ectomorph consume enery, protein, fat vitamin B1, B6, zinc and ritenol in largest amount compare to endomorph and mesomorph. The lower average energy intake was found on endomorph group [19].

This study shows that high energy intake adequacy level can affect endomopprh body shape. Energy intake higher than the need will be stored in body in a form of adipose tissue. Adipose tissue can be found under the skin or popularly

called subcutaneous fat and it was found in mesenterium, omentum and behind peritoneum commonly called visceral fat or fat protecting inner organ. High energy intake in long period will enable the high fat storage in adipose tissue both stored in a form of subcutaneous and visceral [21]. Endomorph women has higher amount lipid cell both the fat under the skin or visceral fat [20]. It is highly probable, in this study fat storage on endomorph women is obtained from higher energy intake (89.68%).

This study concludes that the higher endomorph and mesomorph score and the lower ectomorph score the higher the waist circumference and IMT, the higher the energy intake the higher endomorph score and the lower ectomorph score.

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