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Hierarchical Linear Model for Assessing the Effect of Fruit and Vegetable Consumption, Age and Physical Activity of Abdominal Circumference

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ABSTRACT

The purpose of this research is to examine the effect of the consumption of vegetables, fruit consumption, age and physical activity on the abdominal circumference in East Java. Abdominal circumference is an indicator to measure central obesity data used *RISKESDAS* sourced from 2013. The area is quite wide, and gradually the sampling technique used to produce data with a hierarchical structure, so the approach used hierarchical linear modeling (HLM).The results showed 23.5% of the population of East Java had central obesity, people are in the productive age (21-50) years of 77.5% do not consume vegetables (in the last week) at 2.2% and the 59% who consume vegetables 1 (one) portion or less every day. There are 21.7% of the population of East Java who do not eat fruit in the last week, and 69% who consume fruits 1 (one) portion or less every day. By using HLM (level-1 is the individual and the level-2 district / city), showed that age, physical activity, consumption of fruits individual and district / city affect the abdominal circumference. Population with normal abdominal circumference, had average physical activity is greater than the population that had central obesity. The population groups with a relatively young age tend to do physical activity are low compared with the older age groups.
KEYWORDS: Central Obesity, fruit vegetable consumption, physical activity, age, HLM

1. INTRODUCTION

Obesity is a condition of abnormal or excess accumulation of fat in adipose tissue . Obesity is not just a condition with the amount of excess fat deposits, but also the distribution of fat throughout the body [1]. There are several indicators to measure obesity, including body mass index (BMI), waist circumference, waist circumference, waist circumference ratio flanks (waist hip ratio). Indicator of obesity based on waist circumference, abdominal circumference, waist hip ratio, usually called abdominal obesity or central obesity [2]

Based on BMI, 10.3% of Indonesia's population were obese in 2007, and increased to 15.4% in 2013. For central obesity (based on abdominal circumference), was a higher prevalence is 18.8% in 2007, and increased be 26.6 % in 2013 [3][4].

Several previous studies have found that increased health risk is associated with central obesity compared to the general obesity. From research [5], found that central obesity is based on the abdominal circumference to act more as a risk factor for diabetes mellitus (DM) compared with general obesity based on BMI. Research conducted [6] states there is a significant correlation between central obesity with increased levels of fasting blood glucose and fasting blood glucose 2 hours *postpandrial*. Additionally, central obesity is also associated with coronary heart disease (CHD), the higher the rate of central obesity will aggravate manifestations of CHD appears on the respondent [7]. Research conducted [8], found that central obesity increases the risk of hypertension, dyslipidemia, diabetes, and metabolic syndrome in men and women.

Based *RISKESDAS* 2013, the prevalence of CHD in 2013 amounted to 1.5%. Hypertension prevalence declined to 25.8% in 2013, which in 2007 was still very high at 31.7%. The prevalence of DM increased to 2.1% (in 2013) compared to 2007 were only 1.1%. The prevalence of diabetes is higher among respondents who are overweight and obesity, also in respondents with central obesity. The prevalence of DM was also higher in the group that have less physical activity [3].

Based on [9], the causes of obesity are multi factorial, i.e. genetic factors, environment, psychology and physiology. Children of obese parents are likely to become obese than children of normal parents. Family environment is very influential in the development of eating habits that can lead to obesity. Overeating can occur as a response to loneliness, grief, depression. Energy expended someone will decline with age, it is associated with physical activity undertaken and this often leads to weight gain in middle age. Based [10], energy intake was significantly associated with the occurrence of central obesity in housewives.

Physical activity, consumption of fruits and vegetables alleged effect on central obesity, especially abdominal circumference. In 2007, the population of Indonesia of physical activity most (48.2%) were less active, and in 2013 fell to 26.1%. Consumption of fruit and vegetables population of Indonesia is also very low.

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In 2007 amounted to 93.6% of eating less fruit and vegetables. In 2013, obtained different conditions, i.e. by 93.5% less eat fruits and vegetables [3][4].

This study wants to examine the factors that affect the abdominal circumference. The data used is data *RISKESDAS*, structured hierarchy. Therefore, it will be used Hierarchical Linear Model (HLM) to assess the effect of the consumption of vegetables, fruits consumption, age and physical activity on the abdominal circumference.

2. METHODOLOGY

This study used secondary data obtained from the data of Health Research (*RISKESDAS*) in 2013 were sourced from the Agency for Health Research and Development of the Republic of Indonesia and the National Economic Census (*SUSENAS*) in 2013 were sourced from the Central Bureau of Statistics (*BPS*). The variables studied were abdominal circumference, the consumption of vegetables, fruits consumption, age and physical activity to East Java Province.

Data were analyzed using HLM 2 level, namely the level of the individual and the level of districts / cities, with the approach of Maximum Likelihood Estimator (MLE) [11][12][13]. At the individual level, there abdominal circumference (dependent variable), the consumption of vegetables, fruits consumption, physical activity and age, which is derived from the data *RISKESDAS*2013. At the level of districts / cities have average variable consumption of vegetables per district / city and the average consumption of fruit per district / city, which is derived from the data *SUSENAS*2013.

3. RESULTS AND DISCUSSION

The average age of a resident of East Javais 34.12 years with a standard deviation is 11.182 years. The youngest was 15 and the oldest 54 years. Age is very influential in the abdominal circumference, increasing a person's age, the greater the likelihood for obesity. Population at the age is 41-50 years have the highest likelihood of obesity, namely 32.5%. This can be seen in Table 1.

Table 1 : Distribution of Population Age and Abdominal Circumference East Java in 2013

Age	Nutritional status based on Abdominal Circumference	
	Normal	Obesitas
≤ 20 years	7369 (93.3%)	528 (6.7%)
21-30 years	11396 (81.9%)	2519 (18.1%)
31-40 years	10503 (72.9%)	3911 (27.1%)
41-50 years	9084 (67.5%)	4373 (32.5%)
≥ 51 years	2896 (68.7%)	1322 (31.3%)
Total	41248 (76.5%)	12653 (23.5%)

Physical activity data in *RISKESDAS* categorized into heavy, medium and light. Physical activity is calculated by combining long physical activity (in minutes) of heavy, medium and light, with a long first menggalikan activity by a factor on Estimating Energy Requirements (EER). The average physical activity is a resident of East Java is 4305.544 minutes with a standard deviation 1852.506 minutes, physical activity most small / light is 75 minutes and the most severe is 12902.4minutes.

Vegetable consumption is measured by the number of servings of vegetables consumed for 1 (one) week. The average population of East Java vegetables consumption at 9.8931 (portion / week) with a standard deviation is 7.12646. At 2.2% of the population of East Java does not consume the vegetables in the last week. At 59% of the population of East Java vegetables consumption is1-7 (portion / week). Based on data from *SUSENAS*2013, the average consumption vegetables in each district / city in East Java is 0.7063 kg/week/capita with a standard deviation of 0.27187.

Average consumption of fruit East Java's population is 3.466 (portion / week) with a standard deviation is 4.46769. At 21.7% of the population does not consume the fruit of East Java in the past week. Amounting to 69 % of the population consume 1-7 servings of fruit a week. Based on data from *SUSENAS*2013, the average consumption of fruit in each district / city in East Java is 1.0184 kg/week/capita with a standard deviation of 0.19216.

If physical activity, fruit and vegetable consumption is associated with nutritional status (based on abdominal circumference), then obtained a description as in Table 2.

Table 2 : Distribution of Physical Activity , Fruit and Vegetable Consumption Based on Nutritional Status

(Means ± Std.Deviation)	Nutritional Status (Based on Abdominal Circumference)	
	Central obesity	Normal obesity
Physical activity	4274.16 ±1833.67	4315.17 ±1858.16
Vegetable consumption (portion / week)	10.15 ±7.20	9.81 ±7.10
Fruit consumption (portion / week)	4.02 ±4.99	3.30 ±4.28

In people who have normal abdominal circumference, had average physical activity is greater than the population that had central obesity. For the consumption of fruits and vegetables, tend to be no difference between people who are normal and central obesity.

Analysis of the effect of the consumption of vegetables and fruit , the age and physical activity to the abdominal circumference using statistical analysis HLM, through the following stages:

1. Modeling Model 0 (empty model), or referred to as M0
2. Modeling Level 2 (district /city), or referred to as M1
3. Modeling Level 1 (individual), or referred to as M2
4. Mixed model (district / city and individuals), or referred to as M3.

Table 3: HLM Modeling for Model M0 , M1 , M2 and M3

Parameter	M0		M1		M2		M3	
	Estimation	P-value	Estimation	P-value	Estimation	P-value	Estimation	P-value
Fixed part								
Intercept	77.089	0.000	72.550	0.000	66.4538	0.000	62.0552	0.000
Age					0.2816	0.000	0.2817	0.000
Physical activity					0.0001	0.000	0.0001	0.000
Individual vegetable consumption					0.0120	0.065	-0.0288	0.426
Consumption of individual pieces					0.1693	0.000	0.2797	0.001
Vegetable consumption district / city			-0.036	0.720			-0.0874	0.408
Consumption of fruits district / city			0.174	0.027			0.1908	0.019
Individual vegetable consumption and district / city							0.0032	0.251
Consumption of individual fruit and district / city							-0.0037	0.178
Random part								
R	110.45		110.45		99.87		99.87	
U	2.93		2.52		3.09		2.67	
-2Log Likelihood (-2LL)	396860.46		396855.52		391572.30		391563.92	
AIC	396866.46		396865.52		391586.30		391585.92	
BIC	396893.07		396909.87		391648.39		391683.49	
ICC	2.59%		1.86%		2.99%		2.60%	

On Modeling M3, age, physical activity and consumption of fruits (the individual level and district / city), significantly affect the circumference. The next step is to do remodeling to Mixed Model by eliminating variables that are not significant, through the following stages:

Table 4: Results HLM Modeling for Model M4, M5 and M6

Parameter	M4		M5		M6	
	Estimation	P-value	Estimation	P-value	Estimation	P-value
Fixed part						
Intercept	61.7606	0.000	61.1331	0.000	61.4699	0.000
Age	0.2817	0.000	0.2819	0.000	0.2819	0.000
Physical activity	0.0001	0.000	0.0001	0.000	0.0001	0.000
Individual vegetable consumption						
Consumption of individual pieces	0.2786	0.001	0.2828	0.001	0.1724	0.000
Vegetable consumption district / city	-0.0677	0.508				
Consumption of fruits district / city	0.1922	0.018	0.1879	0.020	0.1767	0.027
Individual vegetable consumption and district / city	0.0010	0.043				
Consumption of individual fruit and district / city	-0.0036	0.180	-0.0036	0.179		
Random part						
R	99.87		99.87		99.88	
U	2.66		2.65		2.64	
-2Log Likelihood (-2LL)	391564.55		391568.99		391570.79	
AIC	391584.55		391584.99		391584.79	
BIC	391673.26		391655.95		391646.89	
ICC	2.59%		2.59%		2.58%	

Residents in East Java who had central obesity is quite high at 23.5%. This figure is still small compared with the national rate, which amounted to 26.6% [4]. The prevalence of central obesity high note, because it is based on several studies, central obesity increases the risk of several diseases, including diabetes, hypertension, dyslipidemia, metabolic syndrome and CHD ([5][6][7][8]).

Population aged less than or equal to 20 years, only a small fraction (6.7%) who had central obesity. Population in the age range 41-50 years experienced the largest central obesity is 32.5%. This is in accordance with [9], the incidence of obesity increases with age. Results of research [13], also stated the same thing, namely age effect on abdominal circumference with an OR of 1.04.

Population with normal abdominal circumference, had average physical activity is greater than the population that had central obesity. This is according to research conducted by [14] which states that physical activity effect the abdominal circumference, with an OR of 2.52. Consumption of vegetables and fruit Residents in East Java was not too good. 59% who ate vegetables 1 portion or less on a daily basis and 69% who consume fruits only 1 portion or less on a daily basis. This condition is not unlike the situation in Indonesia in general. *RISKESDAS* report of the results in 2007 amounted to 93.6 % of eating less fruit and vegetables, and *RISKESDAS* in 2013 amounted to 93.5 % of eating less fruit and vegetables ([3][4]) .

From the data analysis, the value of the ICC of 2.59%. This condition is not much different from the study of [15], which states the ICC value of 3.72%, with level-2 is a neighborhood or region.

In the modeling M0 and M1, the value -2LL, AIC and BIC are almost the same and quite high. In the modeling M2 and M3, the value -2LL, AIC and BIC fall quite sharply, it means M2 and M3 better than the M0 and M1. In the model M3, there are still some variables were not significance, because it is done by issuing a variable repetition models were not significance. The analysis produced a model M4, M5 and M6. Goodness of fit value (-2LL, AIC and BIC) of the model M3, M4, M5 and M6, can be seen in Figure 1.

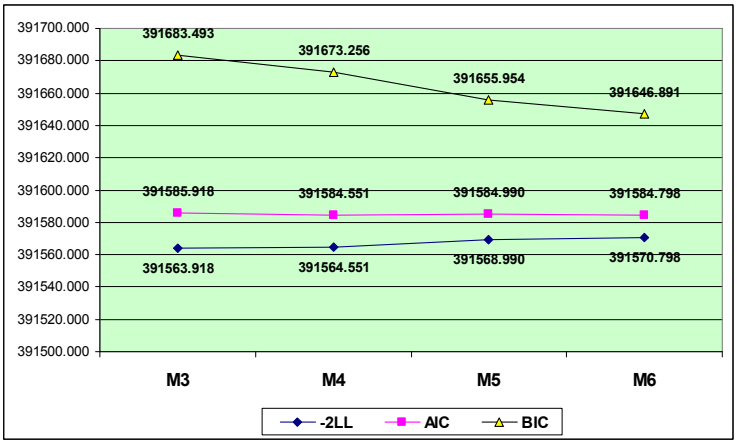

Figure 1: Value -2LL, AIC, BIC in model M3, M4, M5 and M6

Model M6, has -2Log Likelihood and BIC has a value smaller than the other models (M3, M4, and M5). While the value of AIC is almost the same for all models. With that in mind, it can be concluded the model M6 is the best model. Age, physical activity, consumption of fruits individual and district / city affect the abdominal circumference, with the parameter value and significance as in Table 5.

Table 5 : Factors Influencing Against Abdominal Circumference

Variables	Parameter Estimate	P-value
Intercept	61.4699	0.000
Age	0.2819	0.000
Physical activity	0.0001	0.000
Consumption of individual pieces	0.1725	0.000
Consumption of fruits district / city	0.1767	0.027

These results are in line with [16] which states the age is one of the factors that affect the abdominal circumference, besides sex,[15] also stated that physical activity affect the abdominal circumference (Odds Ratio (OR)= 2.52), fruit and vegetable consumption also affects the abdominal circumference (OR = 0.41) .

The parameter value for the consumption of fruit and physical activity in this study has a positive value, it is different from the results of research [10]. Fruit consumption parameter values and positive physical activity this means that if a person's physical activity increases, the abdominal circumference tends to increase, and if the

fruit consumption increases, the abdominal circumference tends to increase. The statement is certainly contrary to the theory. This condition may occur due to consumption patterns and physical activity is highly dependent on age. Population groups with a relatively young age does tend to do physical activity are low compared with the older age groups . The same thing happened in the consumption of fruits.

4. CONCLUSION

Residents of East Java had central obesity of 23.5% to the productive age of between 21 to 50 years, do not eat vegetables (in the last week) at 2.2%, and 59% who ate vegetables 1 serving or less in every day. There are 21.7% of the population of East Java who do not eat fruit in the last week and by 69% who consume fruits only 1 serving or less in every day

Age, physical activity, consumption of fruits individual and district / city affect the abdominal circumference. Population with normal abdominal circumference, had average physical activity is greater than the population that had central obesity. Population groups with a relatively young age does tend to do physical activity are low compared with the older age groups.

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