Association of Physical Activity and Dietary Patterns with Adults Abdominal Obesity in Gorontalo Regency, Indonesia: A Cross-Sectional Study

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Abstract
The study aimed to analyze the association among adults daily physical activities and dietary patterns with central adiposity in the Gorontalo Regency, Indonesia. The study method was an observational with a cross-sectional design. Sampling technique used was purposive sampling, with a total participants of 319. The data of socio-demographic, anthropometric measurement, and physical activity were collected using Physical Activity Level (PAL). While food consumption data were obtained using the method of food frequency and recall 2 x 24 hours. Subjects studied were females (77.7%) and males (22.3%), abdominal circumference for men subjects 82.3 ± 14.6 cm and 84.7 ± 12.4 cm for women, the mean physical activity level on weekdays 1.54 ± 0.2 and holidays 1.53 ± 0.1. Energy intake was higher in respondents with normal nutritional status than subjects with central obesity but did not differ significant between the subject study. In protein intake, there was a significant difference between the subject study, which is, the consumption of protein was higher in subjects with normal nutritional status (97.93 gr) compared to the subjects with central obesity (96.24 gr). Food groups with frequent scores, above 0.43 were rice, fresh fish, kale, tomato, chili, coconut oil, and palm oil. There was association between physical activity and central obesity (p-value 0.027).

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Introduction

Obesity is a major issue in the community due to its economic and health implications. Therefore, it is crucial to concentrate on factors that determine the occurrence, which can be sufficient to prevent possible future incidents. Abdominal adiposity in developing countries, like Indonesia has become a major public health issue. In fact, obesity and abdominal adiposity are becoming crucial health problems due to the triple burden of disease, including communicable and non-communicable diseases, as well as micronutrient deficiency, which has affected the Indonesian population.\(^1\)

Obesity is the principal risk factor for all non-communicable diseases, and along with central obesity, they are significantly associated with the risk of diabetes and hypertension.\(^2\) Abdominal obesity is a significant risk factor of type 2 diabetes regardless of gender, age, and ethnicity.\(^3\) Furthermore, there is a significant association between the waist/height ratio and hypertension.\(^4\) Meanwhile, cancers, type 2 diabetes, and cardiovascular diseases (CVD) are health conditions confirmed as a risk factor from obesity, which establishes a substantial disease burden in many countries, either low-income or high-income.\(^5\) Hypertension, diabetes, and hyperlipidemia were significantly associated with central obesity among adults with normal BMI.\(^6\) In fact, obesity and fasting blood glucose are positively correlated.\(^7\) Visceral fat is associated with risk of cardiovascular disease, it is a potent mediator of unfavorable metabolic profiles, and can be used as assessment of eating behavior.\(^8\)

Food consumption patterns can become a significant indication of diet with morbidity outcomes. Furthermore, identification of food consumption patterns is another possible approach to determine the correlation between diet and non-communicable diseases.\(^2\) General and abdominal obesity have been associated with unhealthy eating patterns based on few studies. Also, unhealthy diet such as processed foods, red meat, high trans fat, sandwich, whole dairy, refined grains, and simple carbohydrates like fried cassava, fried potatoes, salty snacks, sausages, alcoholic beverages, and pasta, have been associated with metabolic disorders.\(^9,10,11,12\) However, healthy eating patterns such as consumption of fruits, vegetables, high-fiber, low-glycemic index, and low-fat meats have a protective effect for central obesity.\(^11,13\) Both meal and snack energy density have opposite correlation with diet quality, and are determined using the balanced diet indicator, which showed positive associations with body mass index and waist circumference.\(^14\)

Obesity and low physical activity are current health issues that account for the increase in non-communicable diseases worldwide. People with this condition generally cannot perform some level of physical activity based on recommendation because of their slight physical fitness and comorbidities. Meanwhile, physical activity associated with energy balance is beneficial to control abdominal fat accumulation and excessive weight, which plays a role in central obesity. Also, high adipokines concentration are secreted by the accumulation of abdominal fat, which is associated with inflammatory processes, general obesity, metabolic syndrome, and hypertension.\(^15\) Low physical activity is also a global health issue which accounts for the increased risk of chronic diseases like diabetes, heart disease, colon, and breast cancers.\(^16\) In addition, physical inactivity, high-fat diet, as well as uncontrolled hypertension, are strong risk factors for cardiovascular complication.\(^17-19\)

Sedentary lifestyle, low fruits and vegetables consumption, and high intake of risky foods have an impact on health status and abdominal adiposity. Based on the national basic health survey, obesity prevalence in the population aged more than 18 years in national percentages was 21.8%, where Gorontalo province was 24.4%, while central obesity
was 31.0%, and Gorontalo Province was 36.6%. Also, this province has a tendency to consume high-risk foods, including the consumption ≥ once per day, such as sweet foods (40.9%), sweet drinks (56.16%), salty foods (10.6%), fatty foods which contain high fat including saturated fat and cholesterol (49.7%), as well as foods with added flavoring (77.2%). Furthermore, soft drinks consumption was (3.2%), energy drinks (3.5%), instant foods (4.7%). Meanwhile, vegetables and fruits consumption is still very low at 93.8%, and on the other hand, less physical activity (34.0%).

This present study is justified by unhealthy dietary patterns, low physical activity, and the incidence of central obesity, which are becoming more frequent in the population, including in developing countries. Therefore, it is necessary to study the anthropometric parameters of the population with dietary patterns and physical activity to help health professionals working specifically with these health problems.

This study aims to assess the association of dietary habits and physical activity with central obesity in adults residing in Gorontalo Regency, Indonesia.

Methods
This is an observational study with a descriptive cross-sectional design carried out in 2019, with adult individuals of both sexes. Furthermore, this study was conducted in Telaga Biru Public Health Service located in Telaga Biru District, Gorontalo Regency. The location was based on a previous study which found obesity prevalence to be 38.7%. Also, calculation of the total sample used a formula for estimating the prevalence in adults residing in Telaga Biru Public Health Service working area with a total population of 1,676. There was a 10% total samples increment to preserve respondents losses, refusals and to manage the confounding variables and total sample (n) of about 319 respondents. Meanwhile, the sampling technique used purposive sampling, in which specific criteria were taken as the samples according to inclusion criteria, including subjects not undergoing diabetes mellitus and cardiovascular disease treatment. Also, the study was registered in research and community service institution Gorontalo University number 002/C.2/LP3M/UG/IV/2019. In addition, all the participants signed Informed consent form.

The data collection using standardized questions was arranged with a structured questionnaire about the characteristics of socio-economic, demographic, anthropometric measurements, physical activity, and food consumption. Furthermore, the data were collected by interviewers and supervisors who were previously trained.

The social economy and demographic variables include: age in completed years and classified into five categories of educational level as defined as "not complete elementary school", "complete elementary school", "junior high school", "senior high school", and "university level". Also, socio-economic level, as determined by income per month is classified as "low and high-income", according to regional minimum wage in local government. The income per month was categorized into two, which were "higher than the regional minimum wage" and "lower than the regional minimum wage" in Gorontalo Province. Furthermore, marital status classification include "married (with a partner)", "not married (single)", and "others (divorce)". According to occupation, it was categorized as civil servant, private employees, entrepreneur, farmers or laborers, housewife, and others. In addition, nutritional status was measured based on body mass index, which was categorized into underweight when BMI score < 18.5, normal when the score is 18.5 – 25, and overweight when score > 25.

The anthropometric measurement was used to assess nutritional status, including body weight, height, waist circumference, middle-upper arm circumference. Furthermore, the waist circumference was measured to determine central obesity, and was assessed between the midpoint of the last rib and the iliac crest. Height was assessed with microtoice 2.5 m, and 0.1cm nearest. Meanwhile, a digital scale was used to measure weight, the nearest 0.1 kg, and the cut-off points for men with waist circumference ≥ 90 cm and women ≥ 80 cm was used to determine central obesity. Also, physical activity was measured using the Physical Activity Level (PAL) questionnaire. It was categorized into very mild activity (PAL < 1.4), sedentary (PAL 1.40 – 1.69), active (PAL 1.70 – 1.99), and vigorously active lifestyles (PAL 2.00 – 2.40).
The food consumption information was measured by Food Frequency Questionnaire (FFQ). Furthermore, eight food groups were administered for the frequency questionnaire. The quantitative FFQ includes questions concerning the dietary consumption patterns of 52 food items. The list of food items represented the society's diet in Gorontalo regency. Meanwhile, additional modifications were created to enhance measurements of food rich in antioxidants (inclusion of essential food sources of antioxidants and fibers, particularly fruits and vegetables). Also, the subjects were requested to recall the average and how often they consumed each food during the last 1 month. The analysis of FFQ questionnaire was based on\(^{24}\) which have the following values for each frequency option: 2 – 3/d = 2.5; 1/d = 1.0; 3 – 6/week = 0.43; 1 – 2/week = 0.14, 1 – 3/month = 0.07; never = 0. There were two categories classification, namely "seldom" when score of food groups is lower than 0.43 and "often" when the score is greater than 0.43. The food portions were defined in household size; and the intake were converted into grams. The quantities of food consumptions measured in the household such as tablespoon (15 mL), 1 slice, or 1 cup (250 mL), reflect 1 standard services for each food. Also, further information was obtained regarding cooking techniques and specific types of margarine, oil (such as palm or coconut oil), butter, and take-out foods eaten. In addition, intake also used recall 2 x 24 hours to access the energy and nutrients consumption of the subjects.

The Mann-Whitney test was used to compare energy and nutrient intake between subjects with normal nutritional status and central obesity. Furthermore, the association between physical activity and food intake pattern with central obesity was assessed using the Chi-square test. The dependent variable was central obesity, and the independent was food consumption and physical activity. In addition, the level significant statistic was 5% (p<0.05), and the analyses were conducted using the statistical package for social science (SPSS) software, version 16.0.

### Results And Discussion

The description of food groups in the frequency questionnaire is shown in Table 1. There were seven groups of food items, and the subjects were asked about their consumption frequency in the last month. The foods include staple, animal-based protein, plant-based protein, vegetable, fruit, fat and oil, and drink groups.

| Food groups       | Food items from Food Frequency Questionnaire                                      |
|-------------------|-----------------------------------------------------------------------------------|
| Staple food groups| Rice, corn, cassava, bread, noodle                                               |
| Animal-based protein groups| Fresh fish, dried fish, squid, crab, shrimp, beef, chicken, broiler, duck, liver, egg |
| Plant-based protein groups | Tempe, tofu, peanut, green bean                                                  |
| Vegetable groups  | Kale, purple eggplant, papaya flower, cabbage, carrot, spinach, long beans, chayote, summer squash, mustard green, tomato, chili |
| Fruit groups      | Papaya, banana, sugar apple, orange, water melon, rambutan                       |
| Fat and oil groups| Coconut oil, palm oil, margarine, coconut milk                                   |
| Drink groups      | Sweetened condensed milk, milk powder, syrup, tea, coffee, soda                   |

The characteristics of the subjects can be seen in Table 2, and were mostly females (77.7%). Based on age groups, 41-45 years was 26.7%, and married status was 71.5%. The educational levels were mostly senior high school (32.9%). According to the occupational status, most of the subjects were housewives (49.5%); most income levels were above regional minimum wage of Gorontalo Province (81.2%). Furthermore, there was 44.8% obesity under the analysis of nutritional status using body mass index. Also, the number of female subjects in this study was higher than a study in Brazil, which involved 50.20% females, the age group was 20–29 years (30.29%), accompanied by subjects aged 30–39 years (25.23%), 8 or more years of schooling (72.76%), intermediate
socio-economic level (64.7%), and marital status of not married (52.3%).

### Table 2: Socio-demographic profile of respondents

| Characteristic          | Total |
|-------------------------|-------|
|                         | n    | %  |
| Sex                     |      |    |
| Male                    | 71   | 22.3|
| Female                  | 248  | 77.7|
| Age (years old)         |      |    |
| 16 – 20                 | 24   | 7.5 |
| 21 – 25                 | 58   | 18.2|
| 26 – 30                 | 39   | 12.2|
| 31 – 35                 | 52   | 16.3|
| 36 – 40                 | 61   | 19.1|
| 41 – 45                 | 85   | 26.7|
| Marital status          |      |    |
| Married                 | 228  | 71.5|
| Not married             | 78   | 24.5|
| Others                  | 13   |  4 |
| Educational level       |      |    |
| Unfinished              | 27   | 8.5 |
| Elementary school       | 92   | 28.8|
| Junior high school      | 57   | 17.9|
| Senior high school      | 105  | 32.9|
| University level        | 38   | 11.9|
| Occupation              |      |    |
| Civil servant           | 25   |  7.8|
| Private employees       | 19   |  5.9|
| Entrepreneur            | 21   |  6.6|
| Farmers or laborers     | 34   | 10.7|
| Housewife               | 158  | 49.5|
| Others                  | 62   | 19.5|
| Income                  |      |    |
| > Regional minimum wage | 259  | 81.2|
| < Regional minimum wage | 60   | 18.8|
| BMI                     |      |    |
| Underweight             | 15   |  4.7|
| Normal                  | 161  | 50.5|
| Overweight              | 143  | 44.8|

The comparison of energy and nutrient intake between normal nutritional and central obesity status was shown in Table 4. Energy intake was higher in subjects with normal nutritional status than those with central obesity, but did not differ significantly between the two groups. Furthermore, there was a significant difference in protein intake among normal and abdominal obesity subjects. Also, protein consumption was higher in those with normal nutritional status (97.93 g) compared to subjects with central obesity (96.24 g) (p-value = 0.021). Other nutrients have significant difference in zinc intake, which is 7.13 mg in normal subjects and 7.80 mg in central obese subjects, with a p-value = 0.014. Meanwhile, the high zinc consumption in subjects with central obesity is due to food source high in zinc such as processed meatballs, fried chicken and fried fish, as well as processed sea fish, such as dried fish and anchovies.

Consumption description based on frequency questionnaire in the food and beverage items was shown in Table 5. Food groups with frequent score above 0.43 include rice, fresh fish, kale, tomato, chili, coconut oil, and palm oil. Meanwhile, rice is a staple food in Gorontalo province, and is consumed almost every mealtime, another staple food commonly consumed is corn. Furthermore, the source of animal protein often consumed include fresh fish, such as fish float, bonito, tuna, herring, and mackerel. The long coastal area of Gorontalo province has already been facilitated to access fresh fish. Also, sources of protein that are widely consumed include dried fish, eggs, tofu, and tempeh, and the commonly consumed is kale. Kale is one of the characteristics in the diet of Gorontalo community; this is because it is fast and easy to grow. Another type of vegetable commonly consumed is purple eggplant and green long bean. The types of vegetables used as a condiment often consumed are tomato and chili. Meanwhile, one characteristic of the Gorontalo people is the availability of chili sauce in each menu and the food generally has a spicy taste. Frequency

The description of anthropometric measurements, physical activity, energy, and nutrients intake were shown in Table 3. Also, the body weight mean of the subjects was 58.6 ± 10.6 kg and height was 153.5 ± 8.4 cm, abdominal circumference in male subjects was 82.3 ± 14.6 cm and 84.7 ± 12.4 cm in females. Furthermore, the mean BMI was 24.9 ± 4.4 and MUAC in female subjects was 26.9 ± 3.8 cm, the mean physical activity level on weekdays was 1.54 ± 0.2 and 1.53 ± 0.1 on holidays. In addition, energy intake was 1,996.9 ± 418.9 kcal, and fiber intake was 15.3 ± 8.9 g.
Analysis of the relationship of physical activity and eating habits with central obesity is shown in Table 6. Mild activity was more common in the central obesity group, with p-value = 0.027, indicating an association between physical activity and central obesity. Meanwhile, eating habits that include frequency of staple foods, animal-based protein, plant-based protein, vegetables, fruit, oil, and beverage groups showed no significant association with central obesity. Also, the results showed no significant association between the incidence of central obesity and food consumption patterns. This is in line with a study on Chinese adults, which found that eating frequency is not associated with obesity. Furthermore, a study found that the dietary bar pattern, red meat processed food (such as sandwich), high protein and animal fat, sausages, salty snacks, fried cassava, fried potatoes, pasta, and alcoholic beverages were correlated with central obesity. This was assessed
by waist circumference (PR =1.254) and waist/hip (WHR) ratio (PR=1.228). In contrast, traditional patterns such as eggs, vegetable oils, cheeses, yogurts, milk, oat, biscuits, granola, bread, cereal bar, vegetables, and fruit were not found to be associated with abdominal adiposity. Similarly, a study in Italy showed no significant correlation between central obesity and healthy diet considered with Mediterranean Diet. Furthermore, variability in food consumption patterns was discussed in the systematic review, in which two patterns were found, namely “western”, “unhealthy” or “processed” and “healthy”, “traditional”, “Mediterranean”, and “prudent”. Unhealthy dietary patterns include consumption of processed food, soft drinks, and sweets snack, which were correlated with an indigent quality of life. In this study, food grouping does not specifically assess unhealthy or healthy food groups, as did several previous studies. In fact, the grouping was based on sources, while the types of food that lead to unhealthy diet include fat, oil, and drink groups. The groups of fats and oil include coconut and palm oil, which is present in daily consumed processing food, such as fried fish, fried tofu and tempeh, as well as vegetables. In comparison, other fats and oil groups such as margarine are rarely used in food processing while the fat source of coconut milk was found in vegetable menus such as coconut eggplant, traditional menus with purple eggplant and coconut milk. Furthermore, drink groups such as sweetened condensed milk, milk powder, syrup, tea, coffee, and soda are classified as rarely consumed by the subjects. The characteristic of healthy dietary patterns includes healthy foods, such as grain, cereals, vegetables, and fruit, which are correlated with quality of life and wellness. Meanwhile, staple food consumption in the daily category was rice (94.4%), animal-based protein was fresh fish (56.4%). Overall, consumption of vegetables and fruit was relatively low in the subjects, except kale, in which 12.5% of the subjects consume it daily. Other types of vegetables consumed almost everyday include tomato and chili. The high consumption of chili was found in both groups, normal nutritional status and central obesity, and bivariate analysis showed no difference between the subjects. This study differs from research on rural Chinese adults, which found that intake of spicy food correlated with an increased risk of abdominal obesity, and fat energy intake might be the cause of this correlation.

Table 4: Comparison of energy and nutrient intake between normal nutrition status and central obesity status

| Energy and nutrient intake | Normal (Mean ± SD) n = 147 | Central obesity (Mean ± SD) n = 172 | p-value* |
|---------------------------|-----------------------------|--------------------------------------|----------|
| Energy (kkal)             | 2004.95 ± 425.50            | 1990.17 ± 414.45                     | 0.625    |
| Protein (gr)              | 97.93 ± 34.93               | 96.24 ± 39.34                        | 0.021    |
| Fat (gr)                  | 81.37 ± 32.92               | 76.59 ± 31.56                        | 0.156    |
| CHO (gr)                  | 234.22 ± 51.31              | 235.39 ± 52.57                       | 0.965    |
| Fiber (gr)                | 15.02 ± 10.30               | 15.56 ± 7.64                         | 0.245    |
| PUFA (gr)                 | 11.72 ± 7.46                | 11.05 ± 6.81                         | 0.604    |
| Chol (mg)                 | 295.25 ± 195.36             | 287.44 ± 174.54                      | 0.924    |
| Vit A (mcg)               | 2235.46 ± 1470.71           | 2478.78 ± 1595.77                    | 0.138    |
| Vit E (mg)                | 8.31 ± 3.93                 | 8.29 ± 3.82                          | 0.88     |
| Vit C (mg)                | 62.68 ± 40.16               | 61.14 ± 39.07                        | 0.745    |
| Sodium (mg)               | 426.49 ± 579.19             | 387.31 ± 537.66                      | 0.941    |
| Potassium (mg)            | 2343.22 ± 852.16            | 2561.03 ± 979.43                     | 0.063    |
| Ca (mg)                   | 437.81 ± 876.90             | 618.14 ± 1177.82                     | 0.777    |
| Mg (mg)                   | 295.66 ± 92.06              | 324.76 ± 118.23                      | 0.051    |
| P (mg)                    | 1236.59 ± 667.53            | 1381.71 ± 843.53                     | 0.108    |
| Fe (mg)                   | 9.31 ± 3.48                 | 9.79 ± 4.20                          | 0.328    |
| Zn (mg)                   | 7.13 ± 3.09                 | 7.80 ± 3.49                          | 0.014    |

*p-value using mann-whitney test (sign < 0.05)
Table 5: Description of food items based on food frequency questionnaire

| Food items           | Daily | Weekly | Monthly | Never | Score |
|----------------------|-------|--------|---------|-------|-------|
| Rice                 | 301   | 18     | 0       | 0     | 1.79  |
| Corn                 | 10    | 132    | 150     | 27    | 0.16  |
| Cassava              | 0     | 67     | 197     | 55    | 0.08  |
| Bread                | 5     | 132    | 152     | 29    | 0.13  |
| Noodle               | 6     | 203    | 80      | 30    | 0.16  |
| Frees fish           | 180   | 131    | 5       | 3     | 1.32  |
| Dry fish             | 17    | 194    | 89      | 19    | 0.25  |
| Squid                | 2     | 42     | 109     | 166   | 0.06  |
| Crab                 | 0     | 15     | 96      | 208   | 0.03  |
| Shrimp               | 0     | 27     | 113     | 179   | 0.04  |
| Beef                 | 2     | 53     | 157     | 107   | 0.08  |
| Chicken              | 5     | 70     | 181     | 63    | 0.09  |
| Duck                 | 0     | 24     | 47      | 248   | 0.02  |
| Liver                | 1     | 32     | 87      | 199   | 0.04  |
| Egg                  | 17    | 266    | 25      | 11    | 0.29  |
| Tempe                | 31    | 248    | 28      | 12    | 0.37  |
| Tofu                 | 31    | 258    | 24      | 6     | 0.36  |
| Peanut               | 2     | 37     | 142     | 138   | 0.07  |
| Green bean           | 1     | 43     | 150     | 125   | 0.07  |
| Kale                 | 40    | 256    | 16      | 7     | 0.46  |
| Purple eggplant      | 13    | 212    | 71      | 23    | 0.21  |
| Papaya flower        | 4     | 81     | 131     | 103   | 0.09  |
| Cabbage              | 4     | 58     | 130     | 127   | 0.09  |
| Carrot               | 1     | 64     | 119     | 135   | 0.07  |
| Spinach              | 3     | 57     | 107     | 152   | 0.08  |
| Long bean            | 4     | 141    | 106     | 68    | 0.12  |
| Chayote              | 1     | 15     | 56      | 247   | 0.03  |
| Summer squash        | 1     | 21     | 48      | 249   | 0.03  |
| Mustard green        | 2     | 68     | 77      | 172   | 0.07  |
| Tomato               | 266   | 40     | 5       | 5     | 1.65  |
| Chili                | 285   | 89     | 30      | 3     | 1.72  |
| Papaya               | 9     | 2.8    | 95      | 22    | 0.18  |
| Banana               | 16    | 5.0    | 87      | 14    | 0.21  |
| Apple sugar          | 0     | 10     | 85      | 224   | 0.06  |
| Orange               | 0     | 13.8   | 125     | 150   | 0.47  |
| Watermelon           | 0     | 12.9   | 134     | 144   | 0.06  |
| Rambutan             | 0     | 13.5   | 131     | 145   | 0.06  |
| Coconut oil          | 143   | 44.8   | 43      | 99    | 0.64  |
| Palm oil             | 163   | 51.1   | 43      | 99    | 1.17  |
| Margarine            | 2     | 1.5    | 57      | 245   | 0.02  |
| Coconut milk         | 4     | 219    | 67      | 119   | 0.17  |
| Sweetened condensed milk | 9     | 2.8    | 83      | 187   | 0.09  |
| Milk powder          | 3     | 31     | 74      | 211   | 0.06  |
| Syrup                | 6     | 1.9    | 91      | 85    | 0.14  |
| Tea                  | 40    | 12.5   | 57      | 36    | 0.31  |
| Coffee               | 48    | 15.1   | 75      | 53    | 0.31  |
| Soda                 | 0     | 0      | 122     | 158   | 0.05  |
Table 6: Association between physical activity and dietary food pattern with central obesity

| Variable                      | Waist circumference | p-value* |
|-------------------------------|---------------------|----------|
|                               | Normal            | Central Obesity | Total |
|                               | N  | %    | N  | %    | N  | %    |
| Physical activity             |    |      |    |      |    |      |
| Very mild                     | 29 | 65.9 | 15 | 34.1 | 44 | 13.8 | 0.027 |
| Mild                          | 100| 43.1 | 132| 56.9 | 232| 72.2 |
| Moderate                      | 11 | 36.7 | 19 | 63.3 | 30 | 9.5  |
| Heavy                         | 7  | 53.8 | 6  | 46.2 | 13 | 4.5  |
| Staple food groups            |    |      |    |      |    |      |
| Often                         | 91 | 48.4 | 97 | 51.6 | 188| 58.9 | 0.319 |
| Seldom                        | 56 | 42.7 | 75 | 57.3 | 131| 41.1 |
| Animal protein groups         |    |      |    |      |    |      |
| Often                         | 57 | 50.4 | 56 | 49.6 | 113| 35.4 | 0.247 |
| Seldom                        | 90 | 43.7 | 116| 56.3 | 206| 64.6 |
| Vegetable protein groups      |    |      |    |      |    |      |
| Often                         | 19 | 59.4 | 13 | 40.6 | 32 | 89.9 | 0.112 |
| Seldom                        | 128| 44.6 | 159| 55.4 | 287| 10.1 |
| Vegetable groups              |    |      |    |      |    |      |
| Often                         | 90 | 44.8 | 111| 55.2 | 201| 63   | 0.542 |
| Seldom                        | 57 | 48.3 | 61 | 51.7 | 118| 37   |
| Fruit groups                  |    |      |    |      |    |      |
| Often                         | 7  | 63.6 | 4  | 36.4 | 11 | 96.5 | 0.378 |
| Seldom                        | 140| 45.5 | 168| 54.5 | 308| 3.5  |
| Fat and oil groups            |    |      |    |      |    |      |
| Often                         | 116| 44.8 | 143| 55.2 | 259| 81.2 | 0.335 |
| Seldom                        | 31 | 51.7 | 29 | 48.3 | 60 | 18.8 |
| Drink groups                  |    |      |    |      |    |      |
| Often                         | 21 | 43.8 | 27 | 56.3 | 48 | 84.9 | 0.725 |
| Seldom                        | 126| 46.5 | 145| 53.5 | 271| 15.1 |
| Amount                        | 147| 46.1 | 172| 53.9 | 319| 100  |

*p-value using chi square test (sign < 0.05)

High energy intake has a positive correlation with obesity. Furthermore, meal or snack energy density were inversely associated with healthy and Mediterranean diet score indicator. Also, body mass index (BMI) and waist circumference (WC) have a positive correlation with energy density based on food consumption. There is a strong positive relationship of meal energy density with diet quality, WC, and BMI compared to snack.\(^{13}\) Meanwhile, eating frequency was positively associated with overweight/obesity and central obesity.\(^{30}\) Besides that, the daily distribution of energy and macronutrient consumption has been repeatedly reported to be associated with body weight management.\(^{31}\) Another study found an association between high energy density from fast food consumption and the increasing number of obesity.\(^{32}\) The evidence data from epidemiological studies have supported the positive correlation between the energy density of total intake and measures of body fat.\(^{33,34}\) Meanwhile, the meal frequency was inversely associated with abdominal obesity prevalence in Korean male adults.\(^{35}\) Also, intake of high fiber foods, such as vegetables and fruits, will have an impact on consumption quantity. This decreases the body mass index, however high meat intake of five times or more daily will increase BMI.\(^{36}\) Another study found that meals and snack intake in women has a positive
correlation with BMI and WC (p ≤0.01). Also, the frequency of snack consumption was significantly associated with overweight and obesity in both sexes (women: OR = 1.26; men OR = 1.22) and abdominal obesity (women: OR = 1.21; men: OR = 1.17). A study using the British Food Standards Agency (FSA score) with food weighed in the dietary record for 7 days showed a higher FSA scores which was low nutrition quality. The FSA scores have opposite correlation with assessed diet quality according the healthy diet indicator and Mediterranean diet score in both male and female (p ≤0.005). Even though the correlation was stronger in the meals time, because of the large contribution to total energy intake (64% to 84%), the FSA snacks score based on energy intake were positively correlated with waist circumference and BMI in females (p<0.005). In this study, specific research was not carried out on the amount of energy, but overall, the energy consumed was determined using a 2 x 24 hour recall questionnaire. Also, intake analysis showed that the average energy consumption of the subjects was still below the nutritional adequacy rate (RDA) for Indonesians which is 2100-2150 kcal per day in females and 2650-2550 kcal per day in males. This may be due to less reporting of food consumption by the respondent study. In addition, energy intake did not differ significantly between subjects with normal nutritional status compared to central obesity, but there were significant differences for protein and zinc intake.

The prevalence of central obesity in this study was 53.9%. This is lower than the findings in Brazil, which found the prevalence to be 59.06%. In this study, central obesity prevalence was higher in females (88.4%) than in males (11.6%). Also, analysis based on sex was found that central obesity in male was 28.2% from 71 subjects and in female was 61.7% from 248 subjects. The results established in this study were similar to findings in 16.780 Indonesian population which used the national basic health survey 2007 as a secondary data. According to the results, the prevalence in the Indonesian adult population was 28%, with the percentages higher in females than in males. The different findings were confirmed in Polish and Tehrani adults, in which males were more likely to be overweight or obese compared to females. Also, a study in Arabian adolescents showed that the prevalence of obesity and abdominal obesity were higher in males than in females. This is in line with a study in the Chinese population that central obesity was higher in females compared to males (43.9% versus 31.1%). The findings in the study were due to factors design, the age category, the different investigation contexts of food consumption, and population.

Physical activity is associated with energy balance, and it supports the control of body fat accumulation in the abdominal region and excess body weight which have an impact on central obesity. The subjects with central obesity were 27.5% and classified as not physically active. A study on adolescents age 16 – 18 years old in Poland showed that the risk of abdominal obesity was significantly lower among adolescents who were physically active. Also, a study on Brazilian adolescents found that active commuting to school for more than 10 mins may reduce 36% of central obesity. Findings on Polish adults showed that moderate physical activity during leisure time decreased BMI ≥25 kg/m². Furthermore, a study on French adults showed a significant association between physical activity and obesity. Another study found that vigorous and moderate-vigorous physical activity have a protective effect and significant association with abdominal obesity. Besides, leisure time such as the duration of watching TV increases the risk of abdominal obesity. Also, active communicating correlates with the improvement of cardiorespiratory health status and an increase in oxygen uptake. Meanwhile, compliance has an impact on high energy expenditure and immediately signifies a negative energy balance. Some research have been conducted to assess the relationship between body fat and physical activity. Nevertheless, the different contexts of physical activity may give different results from the other study. Another aspect that could justify the relation is usual daily activities, like walking, cycling, and other physical activities, which require moderate energy expenditure, promote irisin hormone release that transform white adipose into brown. Furthermore, it would make tissue cells have more mitochondria, and high energy expenditure. Some factors can cause central obesity such as low physical activity, stress, unhealthy nutritional intake, improper dietary patterns characterized by high calorie density, and high contents of trans lipids. Also, stress and poor physical activity lead to the distribution of adipose fat in the body. In addition, the increase of abdominal fat
accumulation is related to stress, through the release of the hormones catecholamines and cortisol.50

Conclusion
In this cross-sectional study, the prevalence of obesity was higher in females compared to males. Furthermore, there was no energy consumption difference in the subjects. Nevertheless, there were differences in protein and zinc intake in subjects with normal nutritional status and those with central obesity. The types of food frequently consumed were rice, fresh fish, kale, tomato and chili, as well as palm oil. In addition, there was an association between central obesity and physical activity, but no association with dietary patterns.

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Conflict of Interest
The authors do not have any conflict of interest.

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