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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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Eating habits included frequency of staple foods, animal-based protein, plant-based protein, vegetables, fruit, oil, and beverage groups showed no significant association with central obesity. There was an association between central obesity with physical activity but no association with dietary patterns.

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. Infact, 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%).[1]

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%.[20] 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.[21]

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 wasused to determine central obesity.[22] 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).[23]

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.

Table 1: Food Groups Questionnaire of the study subject

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 (52.31%).[11]

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
Elementaryschool	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 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.

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, aswell 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

analysis of tomato was shown that daily consumption was 83.4% and chili daily consumption 89.3%. Fruit is still relatively low, i.e below 0.43, and the consumption of vegetables and fruits is relatively low, except for the types of tomato and chili. Because the Gorontalo community is generally known for its spicy foods, tomato and chili are used in almost all food menus. Also, the fat sources often consumed are palm and coconut oil. Another characteristic of eating habit is the consumption of fried foods that are included in the frequent category, and about 51.1% of the subjects use palm oil in food processing every day.

Table 3: Description of anthropometric measurements, physical activity, energy, and nutrients intake of respondents

Variable	Mean ± SD	Min	Max
Height (cm)	153.5 ± 8.4	125.7	181
WC male (cm), n =71	82.3 ± 14.6	58	129
WC female (cm), n = 248	84.7 ± 12.4	52	121
BMI	24.9 ± 4.4	14.5	41.1
MUAC (cm), n = 248	26.9 ± 3.8	18	39
PA day work (PAL)	1.5 ± 0.2	12	2.82
PA holiday (PAL)	1.5 ± 0.1	1.2	2.4
Energy (kkal)	1,996.9 ± 418.9	680	2,990.40
Protein (gr)	92.4 ± 37.5	20	269.8
Fat (gr)	78.7 ± 32.2	10.6	201.1
CHO (gr)	234.8 ± 51.9	95.3	411.3
Fiber (gr)	15.3 ± 8.9	2.7	115.5
PUFA (gr)	11.3 ± 7.1	1.1	36.8
Chol (mg)	291.0 ± 184.1	0	1,186.90
Vit A (mcg)	2,366.6 ± 1541.8	6	9,546.60
Vit E (mg)	8.3 ± 3.8	0	23.1
Vit C (mg)	61.8 ± 39.5	0	248.9
Sodium (mg)	405.3 ± 556.6	19.7	6,188.10
Potassium (mg)	2,460.3 ± 927.7	514.8	5,774.70
Ca (mg)	535.0 ± 1,052.2	53.5	7,450.20
Mg (mg)	311,3 ± 107.7	87.8	746.5
P (mg)	1,315.0 ± 770.0	318.6	5,860.30
Fe (mg)	9.5 ± 3.8	2	44.4
Zn (mg)	7.4 ± 3.3	2.5	24.7

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.[25] 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 adiposit.[11] Similarly, a study in Italy showed no significant correlation between central obesity and healthy diet considered with Mediterranean Diet.[26] Furthermore, variability in food consumption patterns was discussed in the systematic review,[27] in which two patterns was 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.[28] 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.[29]

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
	N	%	N	%	N	%	n	%	
Rice	301	94.4	18	5.6	0	0.0	0	0.0	1.79
Corn	10	3.1	132	41.4	150	47	27	8.5	0.16
Cassava	0	0.0	67	21.0	197	61.8	55	17.2	0.08
Bread	5	1.6	133	41.7	152	47.7	29	9.0	0.13
Noodle	6	1.9	203	63.6	80	25.1	30	9.4	0.16
Frees fish	180	56.4	131	41.1	5	1.6	3	0.9	1.32
Dry fish	17	5.3	194	60.8	89	27.9	19	6	0.25
Squid	2	0.6	42	13.2	109	34.2	166	52	0.06
Crab	0	0.0	15	4.7	96	30.1	208	65.2	0.03
Shrimp	0	0.0	27	8.5	113	35.4	179	56.1	0.04
Beef	0	0.0	61	19.1	161	50.5	97	30.4	0.07
Chicken	2	0.6	53	16.6	157	49.2	107	33.6	0.08
Broiler	5	1.6	70	21.9	181	56.7	63	19.8	0.09
Duck	0	0.0	24	7.5	47	14.7	248	77.8	0.02
Liver	1	0.3	32	10	87	27.3	199	62.4	0.04
Egg	17	5.3	266	83.4	25	7.8	11	3.5	0.29
Tempe	31	9.7	248	77.7	28	8.8	12	3.8	0.37
Tofu	31	9.7	258	80.9	24	7.5	6	1.9	0.36
Peanut	2	0.6	37	11.6	142	44.5	138	43.3	0.07
Green bean	1	0.3	43	13.5	150	47	125	39.2	0.07
Kale	40	12.5	256	80.3	16	5.0	7	2.2	0.46
Purple eggplant	13	4.1	212	66.4	71	22.3	23	7.2	0.21
Papaya flower	4	1.3	81	25.4	131	41	103	32.3	0.09
Cabbage	4	1.3	58	18.2	130	40.7	127	39.8	0.09
Carrot	1	0.3	64	20.1	119	37.3	135	42.3	0.07
Spinach	3	0.9	57	17.9	107	33.6	152	47.6	0.08
Long bean	4	1.3	141	44.2	106	33.2	68	21.3	0.12
Chayote	1	0.3	15	4.7	56	17.6	247	77.4	0.03
Summer squash	1	0.3	21	6.6	48	15	249	78.1	0.03
Mustard green	2	0.6	68	21.3	77	24.2	172	53.9	0.07
Tomato	266	83.4	40	12.5	8	2.5	5	1.6	1.65
Chili	285	89.3	30	9.4	1	0.3	3	0.9	1.72
Papaya	9	2.8	193	60.5	95	29.8	22	6.9	0.18
Banana	16	5.0	202	63.3	87	27.3	14	4.4	0.21
Apple sugar	0	0.0	10	3.1	85	26.7	224	70.2	0.06
Orange	0	0.0	44	13.8	125	39.2	150	47	0.06
Watermelon	0	0.0	41	12.9	134	42	144	45.1	0.06
Rambutan	0	0.0	43	13.5	131	41.1	145	45.4	0.06
Coconut oil	143	44.8	29	9.1	43	15.1	99	31	0.64
Palm oil	163	51.1	14	4.4	23	7.2	119	37.3	1.17
Margarine	2	0.6	15	4.7	57	17.9	245	76.8	0.02
Coconut milk	4	1.3	219	68.6	67	21	29	9.1	0.17
Sweetened condensed milk	9	2.8	40	12.6	83	26	187	58.6	0.09
Milk powder	3	0.9	31	9.7	74	23.2	211	66.2	0.06
Syrup	6	1.9	137	42.9	91	28.5	85	26.7	0.14
Tea	40	12.5	186	58.3	57	17.9	36	11.3	0.31
Coffee	48	15.1	143	44.8	75	23.5	53	16.6	0.31
Soda	0	0.0	39	12.2	122	38.3	158	49.5	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).[37] 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).[38] 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.[39] 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%11. 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.[1] The different findings were confirmed in Polish and Tehrani adults, in which males were more likely to be overweight or obese compared to females.[36-40] Also, a study in Arabian adolescents showed that the prevalence of obesity and abdominal obesity were higher in males than in females.[41,42] 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.[1] 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.[43] Also, a study on Brazilian adolescents found that active commuting to school for more than 10 mins may reduce 36% of central obesity.[44] Findings on Polish adults showed that moderate physical activity during leisure time decreased BMI ≥25 kg/m.[36] Furthermore, a study on French adults showed a significant association between physical activity and obesity.[45] 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.[46] 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.[47,48] 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.[49] 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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