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Light physical activity increased body fat percentage in elderly Javanese

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ABSTRACT

The prevalence of obesity in Indonesia is rapidly increasing, particularly in older people. Obesity is characterized by increased percentage of body fat in the form of visceral fat and non-visceral or subcutaneous fat. The aim of this study was to analyze body fat percentage (BFP) and associated risk factors, i.e. type of residence (rural or urban), physical activity, gender, age, intakes of energy and fat, and socio-economic background (educational level and occupational status). This cross-sectional study was conducted on 812 older persons (517 females and 295 males) from December 2007- February 2008 in the cities of Surabaya, Semarang, Yogyakarta, Wonogiri, Gunung Kidul, and Magetan subdistricts. BFP was assessed using an Omron Fat Analyzer. Nutritional intakes were collected through interviews using semi-quantitative food frequency questionnaire (FFQ). To obtain overall total energy expenditure for physical activity (PA), the energy expenditures for exercise (sports) PA, daily activities, and leisure time PA were added together. The study results indicated that urban residence and light PA at age 55 years constituted risk factors for high BFP. Light PA at 55 years of age was the most influential risk factor, since it was 4.3 times greater than vigorous PA at the same age (OR=4.3; 95% Confidence interval 2.6-7.1) It is recommended to implement nutritional counseling about adequate intakes for increased PA in all age groups (adolescents, adults, older persons), particularly in urban areas with their greater risk of high BFP.

Keywords: Body fat percentage, older persons, rural, urban

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INTRODUCTION

The prevalence of obesity is rapidly increasing in both developed and developing countries. This disorder is steadily increasing in older persons, leading to increased mortality due to degenerative diseases, such as diabetes, hypertension, stroke, and coronary heart disease (CHD). Obesity is characterized by increased total body fat in the form of visceral fat and non-visceral or subcutaneous fat. Both forms of fat increase in quantity with advancing age up to the age of 40 years in males and 50 years in females, stabilize up to the age of 70 years and subsequently decline due to loss of adipose tissue. In addition, more of the body fat in older persons is intramuscular and intra-abdominal.(1) Concurrently, lean mass [muscle mass] declines steadily with age, resulting in an initial increase of body fat percentage (BFP) with age (with peak level in middle age), followed by a decrease and finally a leveling-off in old age.(1) Body fat acts as a reservoir of energy, protects the body in times of illness, protects vital organs against injury (mechanical shock protection), and maintains body temperature (thermal protection). However, excessive accumulation of body fat leads to medical complications in older persons, i.e. the emergence of degenerative diseases. Obesity has become a public health problem, as it is associated with metabolic diseases, among others hypertension, dyslipidemia, and atherosclerosis, all of which may increase the risk of CHD. Accumulation of adipose tissue, particularly in the abdominal or visceral region, plays an essential role in the development of metabolic syndrome, CHD, or both.(2)

Data from the Indonesian Basic Health Research survey for 2007 *(Riskesdas 2007)* indicate that the national prevalence of obesity at age 14 years and over is 19.1%, with waist-hip circumference (WHC) as indicator.(3) The prevalence of obesity is higher in urban areas as compared to rural. The prevalence of obesity is proportional to monthly per capita household expenditure. It is to be regretted that no national data are available on the prevalence of obesity in older persons in Indonesia, but only data from local studies. A study of 296 older persons in Jakarta in the year 2008 found that 27.5% of the males and 22.2% of the females were overweight.(4) There are also extremely few (and relatively obscure) epidemiological data on BFP in older Indonesians. Demographic changes in Indonesia in the last decade have resulted in increased longevity, such that the numbers of older persons are expected to increase. The availability of information on BFP is an urgent need in the prevention of obesity in older persons. These data may be used as input for governmental, private, and other interested parties in designing health programs for older persons, particularly for prevention of obesity in Indonesia. There is thus a need for a study on BFP as one of the indicators for assessing the risk of obesity in older persons, in order to obtain data on prevalence of obesity in older persons. Ethnic Javanese were selected as study subjects, as they constitute the largest ethnic group in Indonesia.(5) The aim of the present study was to determine BFP level and associated risk factors in Javanese older persons aged 55 years and older.

METHODS

Design of the study

This cross-sectional study was conducted from December 2007 up to February 2008 to determine the risk factors of BFP.

Study subjects

A total of 812 older persons (517 females and 295 males) participated in this study. Sample size was determined on the basis of calculations for multiple regression analysis.(6) Inclusion criteria of the respondents were: ethnic Javanese males and females aged over 55 years, apparently healthy, and with good verbal communication. Respondents who were ill, suffering from loss of memory, incapable of adequate speech, paralyzed or unable to stand, and unable to completely extend both arms anteriorly, were excluded from the study. Two-stage stratified random sampling was used to select the study area, comprising 2 stages of selection, i.e. at subdistrict and village *(kelurahan)* level. The subdistricts and villages were randomly selected from a list of all subdistricts and villages in the province. The study sample was taken by simple random sampling from 54 villages in 18 subdistricts.

Assessment of dietary intake and physical activity

Data on daily energy and protein intakes were collected through interviews using semi-quantitative food frequency questionnaire (FFQ), while data on PA at age 55 were collected by means of a structured questionnaire. The respondents were questioned about their history of food consumption and physical activities at 55 years. The purpose of collecting data at this point in time was to find possible associations of nutritional intakes and physical activities in old age with BFP at the time of interview. BFP was measured by a trained nutritionist using an Omron Body Fat Analyzer HBF 352. BFPs were grouped into the following categories: i) Normal 20-30% (women) and 10-20% (men); ii) near high 30-35% (women) and 20-25% (men); and iii) high > 35% (women) and 25% (men).(7)

Daily dietary intakes of a selection of foods (in grams) were calculated from the frequency of consumption of the foods, as follows. Depending on the food frequency time units (daily, weekly, monthly, annually), the frequencies were divided by the appropriate number of days, as illustrated for carbohydrate in Table 1. The columns marked with a cross represent the reported food frequencies, while the rightmost column shows the calculated daily food intakes in grams.

Total energy and protein intakes were obtained from analysis of nutritional data using the Nutrisoft software program from the Center for Nutrition Research and Development *(Puslitbang Gizi)* in Bogor for the year 2005. Inputs for the Nutrisoft program were the quantities of each food type consumed (in grams), while the outputs were the daily intakes of all nutrients making up each type of food.

Adequacy of nutritional intake was assessed by comparison with Indonesian Recommended Dietary Allowances (Indonesian RDA, IRDA) based on age and gender.(8) Nutritional intake was deemed adequate if meeting the minimum of 80% IRDA and inadequate if below 80% IRDA.

Data on physical activity (PA) comprised daily activities (DA), daily leisure time PA, and exercise (sports) PA at age 55 years. Types of DA were adjusted to the type of occupation at age 55 years. In sports PA, three items were evaluated, i.e. type of exercise, duration per week, and frequency per week. Type of exercise was divided into 3 categories, i.e. light (weight = 3.5), moderate (5.5) and vigorous (7.5), on the basis of Durnin and Passmore categories.(9)

Duration of exercise per week in hourly units was scored on a scale of 1-5 as follows: i) score = 1 for a duration/week of <1 hour; ii) score = 2 for a duration of 1-2 hours/week; iii) score = 3 for a duration of 2-3 hours/week; iv) score = 4 for a duration of 3-4 hours/week; and v) score = 5 for a duration of >4 hours/week. Frequency of exercise per week was also scored on a scale of 1-5, in which scores 1–4 corresponded to the actual weekly frequency, while a score of 5 was given for a weekly frequency of >4 times.

Table 1. Frequencies of food consumption reported by the subjects

Food type	Frequency of consumption								Household measures (gram)
	>1x per day	1x per day	3–5 x per week	1-2 x per week	2–3 x per month	1x per month	1-2x per year	Never	
Carbohydrate									
Rice				X					2/7 x 100
Biscuits or crackers							X		2/365 x 50

To find the energy expenditure per minute for a given type of exercise, the score for weekly duration of exercise was multiplied by weekly frequency score, then divided by 7 and multiplied by 60, and finally multiplied by the weight of exercise type. Weighting was applied to all DAs at 55 years.(9,10) For more than one type of DA performed, the weight of each activity was calculated separately, then multiplied by duration/day and by 60. Duration of DA was scored similarly to weekly scores, and calculation of daily energy expenditure per minute was also similar to that for weekly scores. For more than one type of DA, the energy expenditures for each type were added to yield the total daily energy expenditure. Leisure time activity was weighted according to severity of activity,(8,9) and the weights were multiplied by the score for duration per day, which was identical to abovementioned DA scores. Calculation of daily energy expenditure for leisure time activity was similar to that for DAs. To obtain overall total energy expenditure for PA, the energy expenditures for exercise (sports) PA, DA, and leisure time were added together. Level of PA was categorized as light, moderate, and vigorous, on the basis of overall total energy expenditure. A high energy score corresponds to a high level of PA. Body mass index (BMI) was calculated as body weight (kg) divided by the square of height (m).

Statistical analysis

To compare means and standard deviations between independent variables (type of residence, gender, age, educational level, physical activity at age 55, and intakes of energy and fat at age 55) and BFP as dependent variable, the data were analyzed using paired-t tests. Multiple logistic regression analysis was used to determine the relationship between BFP status (high and normal) and associated risk factors. All statistical analyses were performed by means of the SPSS program version 13. Values of $p<0.01$ and $p<0.05$ were considered significant.

Table 2. Distribution of BFP status by type of residence, gender, age group,educational level, employment, and physical activity level at age 55 years

Variables	BFP status			p
	High (n,%)	Near high (n,%)	Normal (n,%)	
Type of residence				
Urban	288 (63.9)	119 (26.4)	44 (9.8)	0.001
Rural	137 (38.0)	111 (30.7)	113 (31.3)	
Gender				
Male	128 (43.4)	89 (30.2)	78 (26.4)	0.001
Female	297 (57.4)	141 (27.3)	79 (15.3)	
Age group (yrs)				
55-65	315 (51.0)	178 (28.8)	125 (20.2)	0.001
66-85	110 (56.7)	52 (26.8)	32 (16.5)	
Educational level				
Low	214 (44.5)	149 (31.0)	118 (24.5)	0.001
High	211 (73.7)	81 (24.5)	39 (11.8)	
Employment				
Unemployed	209 (65.5)	85 (26.6)	25 (7.8)	0.001
Informal sector	151 (38.1)	124 (31.3)	121 (30.6)	
Formal sector	65 (67.0)	21 (21.6)	11 (11.3)	
Physical activity				
Light	155 (57.2)	80 (29.5)	36 (13.3)	0.001
Moderate	157 (57.9)	76 (28.0)	38 (14.0)	
Vigorous	113 (41.9)	74 (27.4)	83 (30.7)	

Table 3 Mean BFP level by energy and fat intakes in respondents at age 55 years

Variable	Mean BFP level			p
	High Mean ± SD	Near high Mean ± SD	Normal Mean ± SD	
Adequacy of energy intake				
Inadequate (< 80% IRDA)	36.3 ± 5.4	29.0 ± 5.2	21.3 ± 5.5	< 0.05
Adequate (>=80% IRDA)	35.8 ± 5.6	28.6 ± 5.1	21.2 ± 6.4	< 0.05
Fat intake	29.7 ± 23.6	27.5 ± 16.4	30.4 ± 24.2	> 0.05

RESULTS

Half of the respondents (52.3%) had a high BFP, while 28.3% had near high and 19.3% normal BFP. Based on the BMI categories, 56.7% of the study subjects was in the normal BMI category and 33.1% was overweight or obese. The frequency distribution of BFP by type of residence, gender, age, educational level, employment, and level of PA at age 55 years is presented in Table 2. Overall, total proportions of BFP status were significantly different for PA levels at the age of 55 years. The percentage of high BFP status was smallest and normal BFP status was greatest in older persons with high PA level. High PA level was proportional to normal BFP status and inversely proportional to high BFP status. Based on type of residence, the proportion of high BFP in urban areas was greater than in rural areas, while normal BFP was more frequent in rural areas. There were differences in high, near high, and normal BFP between rural and urban areas. The proportions of BFP at all levels (high, near high, normal) were higher in females in comparison with males, while normal BFP was more frequent in males. The proportion of high BFP was significantly greater in the age group of 66-85 years, compared with the age group of 55-65 years, whereas for normal BFP the converse was true (more frequent at 55-65 years). Thus it may be concluded that BFP at 55-65 years was significantly lower than BFP at 66-85 years. Regarding PA at age 55 years, older persons with light PA had slightly higher BFPs than those with heavy PA. DA was significantly different from BFP proportion. The proportion of high BFP status was higher in older persons with light PA compared with those with vigorous PA, which may be due to the fact that the latter expended more energy for performing PA.

Table 3 shows mean BFP level by intakes of energy and fat at age 55 years. There was a significant difference in high and normal BFP status for an adequate level of energy intake at age 55 years.

Multiple logistic regression analysis of BFP risk factors is presented in Table 4. The most influential risk factor on BFP status was light PA (OR=4.3; 95% Confidence Interval= 2.6-7.1), indicating that older persons with light PA had a probability of 4.3 times that of older persons with vigorous PA in possessing a high BFP status, after adjustment for urban type of residence.

Table 4. Multiple logistic regression analysis of BFP risk factors

Variable	Coefficient	S.E.	P Wald	OR	95.0% C.I. OR	
Urban type of residence	0.6860	0.2229	0.0021	1.9858	1.2829	- 3.0737
Light physical activity at 55 years	1.4639	0.2545	0.0000	4.3230	2.6251	- 7.1189
Constant	-0.0457	0.1434	0.7501	0.9554		

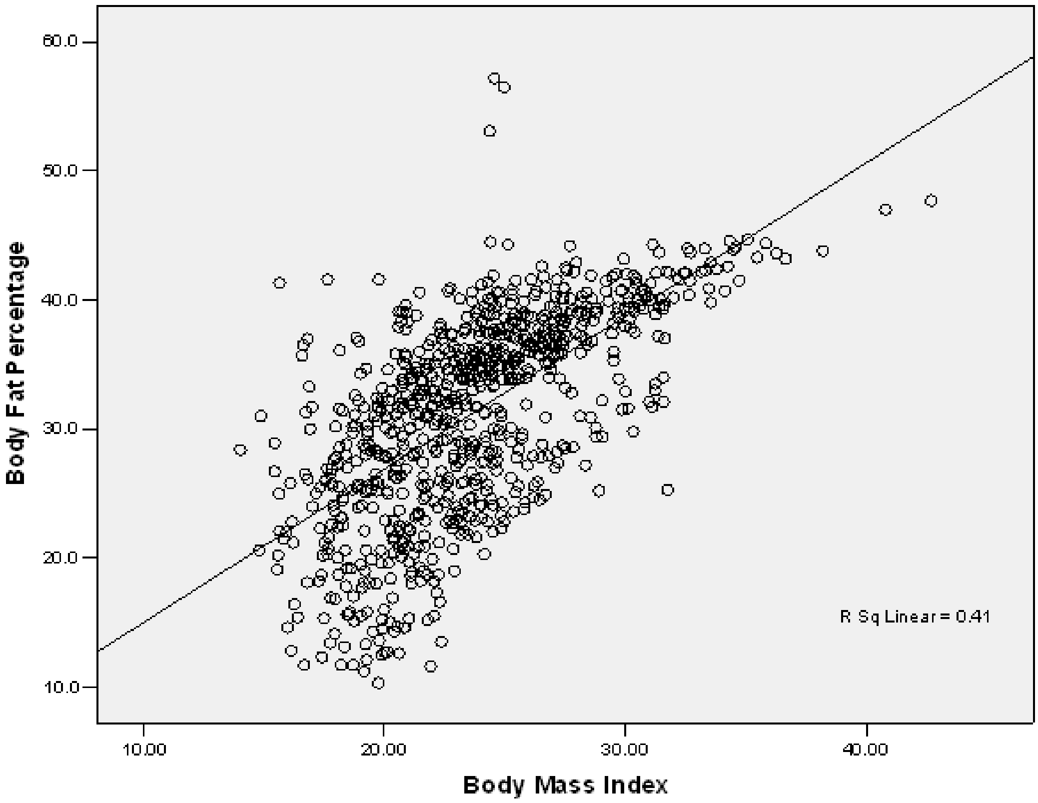

Figure 1. Correlation between BMI and BFP

Figure 1 shows the existence of a correlation between BMI and BFP (r = 0.641), while Table 5 describes the pattern of increases and/or decreases in BFP by increases in body height and weight. In both older men and women, higher body weight was proportional to mean BFP, whereas older women had higher mean BFP than men.

Table 5 Mean BFP by height, body weight, and gender

Anthropometric indicator	BFP	
	Male	Female
Height (cm):		
< 150	27.69 ±7.53	35.31 ± 5.22
150.1 - 160	23.25 ± 6.09	35.39 ± 5.52
160.1 – 175	23.78 ± 5.52	32.41 ± 5.69
Weight (kg)		
30 – 40	- 2.49 ± 0.83	- 1.77 ± 1.42
40.1 – 50	- 2.28 ± 0.98	- 1.64 ± 1.29
50.1 – 60	- 1.97 ± 1.08	- 1.78 ± 0.99
> 60	- 1.75 ± 0.95	- 1.24 ± 1.05

DISCUSSION

The differences in BFP status are caused by life style and dietary habits of urban older persons, who consume more high-fat foods in comparison to rural older persons. This is presumably because urban older persons have high intakes of cholesterol and energy as a result of different dietary patterns. These findings are at variance with those of a study on the dietary intakes of rural and urban older persons in Poland. The energy and macronutrient content of the foods consumed by both groups was similar, except for intakes of several vitamins and minerals, particularly vitamins A and C, which were lower in rural older persons.[11]

The proportion of normal BFP was higher in males than in females, as the latter have a higher BFP than the former. Females have lower PA levels and energy expenditures, and higher energy intakes, while males have a larger lean mass and higher PA levels, and most of their body is composed of muscle.(12)

The differing proportions of the three BFP levels based on age are due to increases in body fat and loss of muscle mass (lean mass) with age in both genders. Older females have entered the menopause, when there is a decreased functioning of the ovaries and estrogens, resulting in increased absorption of calcium. Menopause is a significant predictor of decrease in or loss of muscle mass as a result of estrogen deficiency. The results of the present study are consistent with a study in elderly aged 70–79 years in Pittsburgh, PA, and Memphis, TN, both in the US. These data showed that, in older men and women, later cohorts had a greater BFP than did earlier cohorts. The increase in BFP was due to a larger increase in fat mass and a moderate increase in lean mass. Lean mass was found to decline with age, while fat mass initially increased, but subsequently decreased around the age of 80 years. These changes caused an initial increase in BFP with age, followed by a leveling-off in both older men and women.(13) On the basis of educational level, the present study results indicate that the high educational level group had a greater proportion of high BFP status than the low education group, whereas in the low education group there was a greater proportion of normal BFP status. This is because educational level affects income and ultimately impacts of purchasing power with regard to foods. An age-related decline in physical activity was observed among low-education individuals. For low-education individuals, unemployment and job losses were associated with reduced PA, whereas for highly educated individuals the reverse was true.(14)

The differences in BFP status based on PA level are due to differences in energy expenditure in older working and non-working persons. The lack of a significant relationship between BFP status on the one hand and intakes of energy and fat at age 55 years on the other may be due to the high level of PA of the repondents. When consumption of foods rich in energy and fat is balanced by high levels of PA, then the input calories will be converted into energy, thus there is no accumulation of calories. The lack of a significant relationship between high fat intakes and BFP is similar to the results of a Norwegian study on the influence of dietary fat intake on body fat in middle-aged (47-49 years) and older (71-74 years) persons, in men as well as in women.(15) However, both studies failed to find a relationship between energy intakes and BFP. A high-fat diet may cause increased body fat, since it has a high energy density, while total energy may also be affected by intakes of other macronutrients low in energy, namely proteins and carbohydrates.

Older persons who do not perform active work have a higher BFP, as inactivity affects the distribution of body fat, thus increasing the number of cases of obesity. This is consistent with the results of a study on aging, body composition, and life style in older persons,(16) where physical work was associated with a decrease in BFP in male and female older persons. A somewhat different result was found in New England, where BFP was also inversely related to PA ($r= - 0.37$, $p=0.007$), but in elderly men only.(17) The changes in BFP in overweight and obese older persons were due to increased PA. These findings were contrary to the results of a study on variations in BFP and BMI in Spanish older persons.(18)

BFP in older persons depends on age, menopausal status, and body weight. Increased body weight due to body fat may increase BFP. With normal aging there is a progressive increase in fat and decrease in fat-free mass, the latter being mainly due to loss of skeletal muscle. Consequently, at any given weight, older people, on average, have substantially more body fat than young adults. The increase in body fat with aging is multifactorial in origin, with decreased PA as a major cause, and contributions from reduced growth hormone secretion, declining sex hormone action and reduced resting metabolic rate, and thermic effect of food. There was a proportional relationship between increased body weight and BFP in both genders. Body weight consists of fat mass and lean body mass, and with increasing body weight the percentage of body fat and visceral fat also increases.[19] In older persons there is an increase in body weight as a result of increased energy intakes and decreased energy expenditures through PA. Female older persons have a higher BFP than males, due to the fact that accumulation of fat in males takes place in the upper body (waist circumference, waist/ hip ratio, subscapular/triceps). The body of a woman is naturally built for protecting itself and the fetus in pregnancy, therefore it has numerous enzymes for accumulating and burning fats. Estrogen promotes replication of the enzymes involved in the building of fat reserves. [20]

There were several limitations in this study. First, the cross-sectional design of the study, assessing all independent and dependent variables at a given point in time, has the disadvantage of not being able to find cause-and-effect relationships between BFP and associated risk factors. There is also the possibility of recall bias when the respondents have to recall their sports activities, ADLs, leisure time PA, type and mean level of consumption of carbohydrate and protein sources, as well as their frequencies, at age 55 years. The SQ-FFQ instrument has several advantages in collecting data on longterm dietary consumption, as it is capable of determining the types of foods commonly consumed by older persons and does not affect their dietary habits. The validity of the FFQ method is relatively high, in comparison with other methods. One study on post-menopausal women in China[21] found that FFQ is sufficiently valid in describing the dietary habits of the respondents, since FFQ measures the volume of foods consumed by the respondents and not the weight of the foods. However, this method has several disadvantages, as it requires recall of past dietary patterns, where current intakes may influence reports of past intakes. The method also needs accuracy in estimating food frequency and servings, and there is limited possibility for inserting food specifications into the questionnaire, particularly of local foods not listed in the Nutrisoft software program for analysis of nutritional content. In addition, the relatively long interview period of 30 minutes per respondent results in a high level of inattention, such that the respondent may unthinkingly mention food types, frequency of consumption and food servings. The cross-sectional study design and the inherent recall bias of the SQ-FFQ method may be the cause of the lack of association between energy and protein intakes and BFP.

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